JPRS-UMM-85-007

14 June 1985

USSR Report

MACHINE TOOLS AND METALWORKING EQUIPMENT

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Machine Tools and Metalworking Equipment

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Slow Rate of Implementation

Moscow EKONOMICHESKAYA GAZETA in Russian No 7, Feb 85 p 7

[Article by L. Shprygin, sector manager of NIItsen [Scientific-Research Institute for Prices]: "New Equipment and Economic Interests"]

[Text] How to determine the economic benefit.

In recent years much has been done to intensify the role of prices in accelerating scientific and technical progress. But the measures adopted would give a much more appreciable result if all levers of the economic mechanism were used comprehensively for this purpose. Only by this path can the universal economic motivation to use highly productive equipment, which K. U. Chernenko wrote about in his article, "At the Level of Developed Socialism's Requirements," be achieved.

NIItsen, while working out problems of improving planned price setting, has analyzed the interaction and coordination of such economic levers as wholesale prices and markups and discounts thereon, payments for capital and economic penalties. Questions of their influence on the economic interests of all participants in the processes of the development, manufacture and consumption of highly effective machinebuilding output and on the rational use of rolled ferrous metals were studied.

The research results suggested ways for intensifying the effectiveness of economic levers in this area.

Markups and Quality

Let us take, for example, the matter of the establishment and use of markups to the wholesale price for highly effective output and of financial methods for distributing the economic benefit of the new equipment. Such markups raise considerably the economic motivation to improve product quality, since up to 70 percent of the funds obtained are directed into the economic incentive funds of the creators of the new equipment. An increase in the sum of incentive markups established for the effectiveness of the output produced reflects an acceleration of the pace of technical progress. It is indicative that the funds obtained from markups on machinebuilding output in 1983 increased by almost 1.5-fold over 1982, and amounted to 706 million rubles.

At the same time, manufacturers often create not a basically new, highly effective machine but confine themselves to improving that which already exists. Therefore, the share of these markups, which do not exceed 10 percent of the wholesale price in the total amount of the markups, is substantial.

Markups to Wholesale Price for Producing Effective Machinebuilding Output in 1984

Markups in percent of wholesale price	Percent share of amount of markups
30	6.5
10-30	38.5
Less than 10	55

The data in the table confirm the conclusion that stimulating technical progress by means of prices and markups should be fortified by other economic methods.

Questions of distributing the economic benefit from new machinery and of incentives for suppliers to meet the customers' requirements with precision also were examined.

Development of the specialization and cooperation processes is making the problem of working out methods for motivating enterprises in accordance with the contribution they make to a rise in the quality of machinery to which markups are established especially pressing. In our opinion, it is desirable here to develop coefficients for determining the economic benefit among the enterprises that manufacture the output and, on that basis, of the funds obtained by adding the markups to the wholesale price. Nowadays, the entire total of these resources remains with the manufacturer of the final product. However, in many cases the rise in quality is provided not by design improvement but by the use of improved materials.

Let us examine, for example, the ingredients of the economic benefit from machinebuilding output to whose wholesale price markups have been established. NIItsen's analysis of the factors that influence the economic benefit from the production and operation of the equipment indicates that the increase in the machinery's productivity in most cases provides no more than 30 percent of the total economic benefit. Approximately the same portion of the benefit is achieved by an increase in service life, the remaining 40 percent by savings on current expenditures. The indicators vary for various machines. For example, the share of economic benefit obtained through increase in service life is up to 80 percent for portal and traveling gantry cranes, 30 percent for overhead traveling cranes. The data on agricultural equipment are typical (see the table, "Structure of the Economic Benefit from Agricultural Machinery").

Speaking about an overall approach, the machinebuilders should, in our opinion, get no more than 75 percent of the total markup. It is desirable that the remaining 25 percent be apportioned among the suppliers of the material resources, thereby encouraging improvement of their consumer properties.

In regard to establishing the amount of markups to the prices of the various articles, this depends, of course, upon the contribution of the enterprises to the benefit gained. The developers of new machinery, when substantiating a draft of new prices, could propose to Goskomtsen [State Committee for Prices] that the funds from the markups be distributed by deductions from the manufacturing enterprise's profit.

A similar situation arises also in other branches of the national economy. In our view, precise recommendations about the distribution of the economic

benefit among enterprises that take part in creating the new product are necessary.

Structure of the Economic Benefit of Agricultural Machinery (in percents)

Type of machinery	Increase in productivity	Increase in longevity	Savings of current and other outlays for operations
Stationary MP-7A machine for grafting grape cuttings..............	2	-	98
MLK-4.5 hemp thresher...............	6	-	94
TVK-80B transporter-distributor.....	13	33	54
BM-6A toolbar plant-top collector...	60	-	40
VDP 50 A diaphragm-type pasture water lifter.....................	97	-	3

There are also other complications in the incentives for raising product quality by means of prices. The fact is that the calculation of economic effectiveness that has been coordinated between manufacturers and customers often proves to be overstated.

It is possible, in our view, to insure the economic responsibility of manufacturing enterprises for confirming the efficiency of new machinery by increasing cost-accounting incentives for a maximum reduction in production outlays. Many principles of the economic experiment being conducted in industry do this. It turns out, as a result, that the price factor in raising production effectiveness can keep the influence in the required direction by means of plan indicators and methods for evaluating the collective's work.

How are the components of the economic benefit determined? A rise in the productivity of machines in an overwhelming number of cases is the result of the efforts of machinebuilding enterprise collectives and the improvement of machinery designs, although in some cases the use of higher-quality materials is an influence. As for the increase in longevity, this result is provided through the use of higher quality metals in 30-40 cases out of each 100, and through improvement in the machine's design in only 10-20 cases.

Economic practice must consider the reason the benefit materialized when the economic benefit, and, accordingly, the funds from the markup affixed to the wholesale price are further distributed among the machines' manufacturers and the suppliers of the materials.

Let us dwell now on questions of economic incentives for the machinery's customers to use it effectively. New equipment that is still new lies in the warehouse after it is delivered to the customer. A reduction in reserves of uninstalled equipment and the removal of obsolete and worn machinery from operation will enable scientific and technical progress to be speeded up and metals and other material resources to be used more rationally.

Often a substantial time interval is observed between the manufacture of equipment and its introduction into operation. At a number of enterprises that we have surveyed, this interval is 3-5 years. Thus, at the Uzlovaya Machinebuilding Plant imeni I. I. Fedunets a large amount of equipment introduced had not been used for several years. In 1980, for example, out of

24 units of equipment, 13 experienced forced downtime of this sort for 2 years. In 1983, 10 units of the equipment had been inactive for more than 2 years prior to its introduction into operation.

An increase in above-standard reserves of metal can be observed at a number of machinebuilding enterprises. An analysis of the structure of the arrival and use of rolled ferrous metals testifies that, for machinebuilding as a whole (for 11 ministries), during the current five-year plan the amount of unused rolled metal exceeds the amount that arrives.

Such instances are explained to a great extent by the fact that the enterprises do not bear enough economic responsibility for the use of material resources and equipment, and they develop their production facilities basically through budget resources and not from their own financial sources. It is desirable that enterprises that develop production through their own financial resources be freed for 1-2 years from paying for the use of capital but simultaneously pay more for the use of capital for those funds that are created through the state's financial resources.

The cost-accounting responsibility of enterprises would be intensified by introducing penalties for the nonuse of equipment through their fault. Penalties could be established in the amount of 6-10 percent of the cost of the equipment, to be paid into the budget by the enterprise from the profit remaining at its disposal.

Much metal could be saved also, in our view, as a result of more precise regulation of the relationships of metal suppliers and their customers. Thus, the problem of shipping billets only of the size needed by the customer still has not been resolved.

Recently the economic responsibility of enterprises for the observance of contractual commitments has been intensified. At the same time, the customers' requirements for quality of the equipment or materials shipped are not always met. For example, 755 kg of chips were left after the machining of a 980-kg billet which was obtained from the Neva Plant imeni Leinin, which was used for producing gear shafts for cranes at the Leningrad Plant for Elevating and Transport Equipment imeni Kirov. It is desirable to add new economic levers to the existing ones.

In our opinion, additional expenditures connected with machining billets of excessive weight should be completely compensated for by the supplier. The source of the necessary funds can be the profit from the realization of such billets. For this purpose, metal consumers could pay the suppliers on the basis of the listed prices, only for the amount of metal that corresponds to its consumption in accordance with the norms for the variety of metal ordered.

The measures proposed for intensifying the responsibility of enterprises for the rational use of material resources and equipment would promote, in our opinion, an acceleration of the intensification of production.

Mixed Return on Investment

Moscow EKONOMICHESKAYA GAZETA in Russian No 7, Feb 85 pp 8

[Article by Pavel Ivanovich Plandin, general director of the Arzamas Instrumentmaking Association of Arzamas, Gorkiy Oblast: "How We Are Introducing New Machinery"]

[Text] The role of reequipping enterprises and supplying them with modern equipment grows during the intensification of production. In this matter, much depends upon the producers themselves. General Director of the Arzamas Instrumentmaking Association P. I. Plandin shares his thoughts on this problem.

Pavel Ivanovich began his labor journey at the Gorkiy Motor-Vehicle Plant in the brigade of the celebrated blacksmith, A. Kh. Busygin. Simultaneously, in the evenings he studied in a polytechnical institute. Upon completion of the vuz, he worked as a foreman and department chief at Perm and as chief engineer at Pavlov-on-the-Oka, and since 1958 he has been in charge of the Arzamas instrumentmakers.

Specialists of our association recently estimated that three-fourths of all growth in labor productivity has been provided by reequipping. It was this factor that helped us to surpass the strenuous 1981-1984 program. Using new equipment efficiently, the collective is planning to complete the task for the five-year plan as a whole ahead of schedule.

It stands to reason that we do not forget either about another component of the increase in output with fewer workers. Specialization of sections, the brigade form of working, a combining of trades and expansion of servicing areas, and improvement of vocational skills and training of workers in economics are giving good results. Organization of the job itself in the departments, continuity of the supply of the various materials and tools, and observance of contract discipline by partners also are of great importance. However, the most tangible result was given primarily by an acceleration of technical progress.

Is Everything Keeping Pace?

It is my conviction that in reequipping production facilities, diametrically opposing points of view are, at first glance, equally inacceptable. One of them, parasitically passive, is constructed on the principle, "We will install what they allocate." I would call the other actively customer-oriented, "Update everything quickly." The golden mean consists in the process of reequipping being strictly controlled, planned and purposeful, considering the actual situation both at the enterprise itself and the potential of other branches of industry that ship equipment.

Let's take a look at our association's periodically updated certificate of capabilities. Right now it records that 49 percent of the machine-tool inventory is less than 10 years of age, while the remainder is much older. Of course an age census alone of the machine tools cannot serve as an excuse for writing them off. Everything depends upon whether they are capable of

insuring the necessary precision and rapidity in machining parts or the good-quality execution of other operations. But a fact remains a fact: the pace of rejuvenating the active portion of our fixed capital should be higher. We are glad that recently this trend became more appreciable: while in 1982 updating was 2.9 percent, in 1984 it was 4.6 percent, and now it is expected to be 7.2 percent. We estimate that this dynamic will be maintained during the 12th Five-Year Plan.

The machining centers (OTs's) we ordered from the Ivanov machine-toolmakers and from the Vladimir Tekhnika Association deserve the nicest words. Each OTs, and we have already received 16 of them, right away replaces several ordinary machine tools and frees production space and two or three, and at times even four, workplaces. The microprocessor-supported machine tools received from Kuybyshev and from the capital's Krasnyy Proletariye also have good operating features.

We are striving to install the new equipment quickly and to load it up to the maximum and in well-thought out fashion. For example, a separate specialized section made up of automatic machine tools with NC has been created by our industry, and an automated resetting-up system is to be introduced later. Machining centers also have been installed, not in isolated fashion but concentrated to the extent possible, which, in addition to everything else, facilitates and lessens the cost of servicing.

Calculations indicated that more expensive but truly highly productive equipment completely justifies itself, without reducing return on capital. Unfortunately, the principle that prices for equipment will depend on productivity and economy of operation is observed not always and not by all manufacturing enterprises.

Along with the equipment that is excellent in all respects, at times innovations that are expensive and poorly productive are recommended to us. For example, the robotized turning centers that Savelov's Progress Association send are nothing special. Indeed, each of them costs neither more nor less than 25,000 rubles. The gate and other valves of the pumping station in the thermoplast automatic machines of the Khmel'nitsa plant often go out of commission, leading to downtime, a slowing of the normal rhythm and a shortfall of articles. The money spent on such equipment is regretted.

By Our Own Efforts

In preparing the certificate of plant capabilities and the plan for reequipping the production facility this year and during the next five-year period, we present accurately when, where and what is to be replaced. We also know approximately how much and just what equipment is to be allocated centrally, and in which time periods. Can we be limited to that?- Impossible. For then growth in labor productivity and output would be much less than what has been achieved. We would like not only to maintain the pace adopted but also to exceed it, the more so because the demand for our products is increasing. For example, the Legenda cassette tape recorder and the Evrika tape player, which are specially improved, do not gather dust on store counters.

That is why the collective decided not to be satisfied with the means of production that have been funded, not to sit with folded hands, but to do much

with our own forces, including the mechanization of loading, unloading and storage operations.

A specialized design section, which is engaged in developing new and modernizing existing equipment, was created in the association without any overall increase in manning, thanks to more rational assignments of engineers and technicians. Our specialists successfully rigged a large number of lathes with rugged, compact NC devices of our own fabrication, which proved to be more convenient than those obtainable on order. It is true, these simple and reliable systems still have not been taught to interact with the computer, but the problem is now close to solution.

It is also important to note that tens of retooled machine tools have been ganged and are operating with robots attached to them, which we also did not buy but made at our plant. This worry was assigned mainly to the experimental department, but repairmen and workers allocated from available personnel of other subunits helped. In addition to that, they and the instrumentmakers are providing the section with scarce, complicated attachments and various tooling and tools with wear-resistant coatings.

Where Do the Resources Come From?

During 1985-1990 we shall modernize more than 300 units of equipment and attach to them manipulators, half of which we shall fabricate ourselves. All this is recorded in the plan for introducing new technology, strictly monitored as to date, amounts and quality of execution by the engineering and economic services and the association's management. The originators of the best developments and those who translate an idea into metal will be rewarded materially in accordance with a special bonus regulation.

I am expecting a completely natural question. Where, one says, will we get the metal and other materials and the outfitting items for modernizing existing equipment and for fabricating new equipment. We shall partially cover the requirement through a saving of the resources that are allocated under the basic production program, while we shall order the remainder through the supply organs. I will say frankly, however, that this problem has not been fully adjusted. "Procurement" often involves great difficulties and an expenditure of time and nerves.

Although it is on record that, for reequipping that is performed by our own forces, everything that is necessary should be allocated on social bases, that is, in the planned procedure, this excellent rule is not always observed in practice. Obviously, it is desirable, more objectively, to involve the glavsnabs of the branch ministries and regional USSR Gossnab organs in this.

What the Workplace Will Be Like

Reequipping is not an aim in itself, not a mechanical replacement of obsolete equipment by new, modern equipment. Therefore, reequipping is done in organic conjunction with certification and rationalization of workplaces.

It should be admitted here that at first we permitted hastiness, we were absorbed in the most rapid conduct of "measures," and some comrades reported

completeness of certification, which was limited just to organizing the uninterrupted supply of tools and tooling to the machine-tool operators without touching upon other more important aspects of the problem. Everything had to be repeated and done over properly, as they say.

In realizing simultaneously the plans for introducing new equipment and the certification of workplaces, we have already replaced many tens of equipment units that have served out their service life. They have been transferred to neighboring economic organizations and vocational-technical schools for the execution of less important work or have been written off and sent to be melted down. In these sections, the more productive equipment installed in its place will enable the plan for number of workers to be cut by 15-20 percent, and then there will be half as many as formerly.

The service for production preparations, acting jointly with the management of the departments, answers for the interchange and erection of the equipment. This work is done as a rule on off-work days, so it will not affect adversely the goals set for the various collectives and the association as a whole. Moral and material incentives are awarded to engineers and technicians who participate in reassembling that is completed in less than the standard time.

According to preliminary data, by rationalizing workplaces we will be able at the start of the next five-year plan to free almost as many people as will be needed to man the departments that will be expanded. We have to approach just as calculatingly satisfaction of the requirement for additional production space. Most of the auxiliary services we have transferred to arch-type premises, and for new equipment we are making additions to the permanent buildings by the in-house method.

These days the association is increasing the pressure in the competition for a greeting to the 40th Anniversary of the Great Victory and the half-century anniversary of the Stakhanovite movement and in honor of the 27th CPSU Congress. Among the main points in our socialist commitments for 1985, a 1 percent growth in labor productivity, a one-half percent reduction in the prime cost of output, and 2 days of operation on resources that have been saved are called for.

11409
CSO: 1823/109

INDUSTRY PLANNING AND ECONOMICS

BAL'MONT ON QUALITY, UTILIZATION OF MACHINE TOOLS

Moscow PRAVDA in Russian 11 Mar 85 p 2

[Article by B. Bal'mont, USSR minister of the machine tool building and tool industry: "Along With the Consumer"]

[Text] Each year machine building has a greater impact upon modernizing the productive capital of the nation. The role of machine tool building has also been growing in this process. This is apparent in the higher rates of developing and manufacturing modern automated equipment and high-quality tools. Over the 4 years of the five-year plan, as a whole for the nation, the manufacturing of machine tools with numerical control (N/C) has increased by 1.6-fold and their share in the total output volume of machine tools has risen from 24 to 32 percent. Our sector alone over these years has supplied the national economy with over 31,000 such machine tools, of which 3,500 manufacturing centers. Some 1,400 new, highly productive automatic and semiautomatic lines were manufactured.

The range of flexible automated production modules and systems has been widened. The Leningrad Association imeni Ya. M. Sverdlov, for example, has manufactured a five-coordinate boring and milling machine for three-dimensional machining of parts up to 40 m long and equipped with the newest Soviet N/C systems. The plant is presently developing highly productive automated equipment for machining particularly complex parts weighing up to 12 tons.

The Ivanovo Association imeni 50-letiye SSSR is also operating successfully. Its collective has promised to deliver this year some 15 machining centers to the ZIL [Automotive Plant imeni Likhachev] Association and these will operate under fully automatic conditions. In addition to the plant, the association is to develop three types of modular machining centers which can be incorporated in the flexible production systems.

Automated equipment is also being developed for preparatory production using metal- and energy-saving production methods. As a whole for the nation, the output of forging-stamping equipment has increased since the beginning of the five-year plan by more than 18 percent. There has been a drop in the output of small presses with manual control and a substantial broadening of the production of progressive equipment, including forging complexes equipped with devices for delivering and receiving the stock and industrial robots.

Here we have given only certain, most noteworthy achievements in machine tool building. With each year there will be more and more of them. In the plans and socialist obligations of the sector for 1985, an emphasis has been put on accelerating the automation of machine building. The output of machining centers is to increase by 34 percent, N/C forging-stamping machines by 47 percent, industrial robots by almost double and wear-resistant metal-cutting tools by 1.3-fold.

It must be admitted that we still do not sufficiently utilize the opportunities for increasing the output of N/C equipment by cooperation between the enterprises. We must establish contact also with a number of sectors which are major consumers of flexible modules and machining centers in order to broaden their output for these centers for cooperating in the production of assemblies, units and accessories. We propose that with the aid of the USSR Gosplan such pooling of forces is possible.

Of the numerous problems in scientific and technical progress in machine building, of the most urgent significance at present is increasing the quality and reliability of the new equipment. The main goal here is to bring about an increase in the length of failure-free operation of the equipment. Until recently, the design and engineering organizations were not profoundly concerned with this problem. At present, we are completing the elaboration of a system for norming equipment reliability and a procedure for setting increased norms and incorporating them in the documents and methods are being improved to check reliability.

At the same time, increased equipment reliability is largely determined by the quality of the preassembled control systems and other articles which our enterprises receive from related sectors. For this reason, the machine tool builders must institute a more precise and professional type of cooperation with the related sectors during all stages of developing new equipment: in working out the technical specifications, in receiving the working up new prototypes and in incorporating them in the basic equipment.

We have experience in such collaboration and it is very effective. Thus, in a short period of time the scientific organizations of two related ministries developed the Elektronika NTs 80-31 N/C microprocessor system for new machining centers. The Ryazan, Ivanovo and other associations as well as a number of institutes took an active part in testing and developing it. There was a general desire to develop a system which in terms of its technical level would be up to the best foreign models. In the near future, this equipment is to go into series production.

There are also problems of another sort. We cannot help but be concerned by how the consumers employ the expensive automated equipment manufactured by our plants. We have had to draw attention to this time and again. The major outlays on such equipment can be justified only with two- and three-shift load factors and with good production preparation and skillful personnel. In and of itself the mere replacing of old machine tools with highly automated ones does not produce the expected effect.

Obviously, it would be wise to institute a procedure for obtaining them analogous to orders for special types of equipment and automatic lines whereby the newly developed equipment is worked into the current production conditions.

The USSR Gosplan and the USSR Gossnab have an opportunity to prevent the scattering of such equipment over numerous enterprises. Concentration and methods of group part machining will make it possible to use it more efficiently. Obviously, a portion of the machining centers and flexible modules should be specially concentrated at individual plants for serving other enterprises of a region. Such a practice has produced good results in using an automatic section at the Moscow Stankokonstruktsiya [Machine Tool Design] Plant.

With the increasing scale of machine building automation, it is important to promptly train the workers and setters of the appropriate skills. Unfortunately, in our sector we have not been promptly concerned with broadening the retraining of personnel. During the current year a number of measures have been adopted. We plan to train 6,000 workers in more difficult professions directly on the job. The base vocational-technical schools will train more than 1,500 skilled workers for operating N/C machine tools. The training of specialists in technical schools for producing and operating flexible production systems will more than double. Ever-larger numbers of managers and specialists are mastering the knowledge and skills in the area of program control systems, robotics and automated design systems. For these specialties in the sectorial institute for advanced training of the personnel, around 4,000 specialists will undergo retraining.

The rates achieved for product output, particularly for its progressive types, and the increased efficiency of production are a solid basis for carrying out the taut quotas and obligations of the year.

Unfortunately, the shift factor of equipment operation is still low, and the completion of a series of new capacity is being held up. At times newly created enterprises are based upon obsolete equipment.

There are also flaws in executor discipline, in management and supervision. The planning and organization of production must be improved. There are still enterprises which lag behind for various indicators. The sales plan considering contractual deliveries was fulfilled last year by 98.3 percent and now, under the conditions of the economic experiment, this is completely inadmissible. At present, this situation is being rectified. Over the 2 months, fulfillment was 99.2 percent.

We must increase the production of high-precision special machine tools and machines. As yet the capacity being developed for this purpose at a number of plants is unsatisfactorily utilized. It also happens that in installing and starting up complex equipment at the consumers, production and design flaws are discovered and this is the result of the insufficiently careful testing of the equipment at the manufacturing plants. Sectorial science does not always take into account the long-range trends in metalworking. It is essential to strengthen the scientific research institutes, the large design bureaus and plants with specialists in electronics and computer equipment. All of the enterprises should show a more self-critical approach to assessing the technical level of

the products being developed. A good deal must be done also to improve the management of the sector as a whole.

In endeavoring to properly celebrate the 27th Party Congress and the 40th Anniversary of the Victory of the Soviet People in the Great Patriotic War, the labor collectives of machine tool builders for the final year of the five-year plan have accepted taut socialist obligations. A decision has been made for the entire sector to operate 2 days using saved materials, raw products and energy resources and manufacture above the plan 30 million rubles of finished products and 800,000 rubles of consumer goods.

The results of the first months of work during the new year under the conditions of the economic experiment make it possible to feel that the sector will prepare successfully for the start of the 12th Five-Year Plan. At present, a draft plan is being worked out in detail for the next 5 years. The main task is to develop in machine building a progressive fleet of metalworking equipment, including pressure working methods. By increasing the technical level of the equipment, we must create a qualitatively new machine building base which will make it possible to automate production widely.

10272
CSO: 1823/117

ECONOMICS OF EQUIPMENT REPAIR, METAL CONSUMPTION

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA EKONOMICHESKAYA in Russian No 3, May-Jun 84 pp 46-57

[Article by L. L. Zusman: "Reserves for Saving Metal and Rebuilding Fixed Assets"]

[Text] Examines questions of reproducing fixed production assets of the national economy through major overhauls requiring large social expenditures of labor and metal. Proposes a number of organizational measures in the area of machine design and centralized repair, as well as a number of steps to involve manufacturing enterprises in major overhauls of and modifications to the machines they produce.

The transfer of the economy to primarily an intensive path of development also assumes intensification of the processes of updating, modernizing and overhauling fixed assets and production capacities. In particular, reducing operational expenditures of metal used for repair needs and to replace rapidly-wearing items is an important reserve for increasing the effectiveness with which fixed assets are used. Thus, depreciable scrap metal is generated in the course of using fixed assets and circulating capital in the national economy. In terms of volume, excluding liquidation of fixed assets, it equals the scrap metal resources generated in machinebuilding and metalworking (20.8 and 20.2 million tons, respectively, in 1981).

A systems approach to resolving questions of increasing the effectiveness with which the production base of the national economy functions requires that we determine effective proportions of full and partial reimbursement of the physical-substantive form of the production apparatus, as well as improve the methods of actualization so as to ensure continuous modernization and updating of that apparatus.

When viewed as a basic form of continued production potential development and accumulation, retooling branches of industry and the national economy must ensure a rise in the technical level, increased effectiveness of updating fixed production assets and maintenance of those assets in working condition. This is especially important during the transition to primarily an intensive type of economic growth.

The renewal of fixed production assets is one of the most important problems of the reproduction process in the national economy. It can be effected by eliminating and replacing obsolete and obsolescent assets, supplementing them with newer, progressive types, and by renovation and retooling. Heretofore, the replacement of production fixed assets with progressive types has been of secondary importance, with the primary methods being new construction and expanding the capacity of existing enterprises.

Reproduction Structure of Capital Investments for Nine Basic Branches of Industry, in percent.

	1975	1980
maintenance of production capacities (major overhaul)	13.8	10.1
renovation	10.9	4.9
retooling	3.5	14.2
expansion	24.7	21.1
new construction	36.4	36.8
equipment not a part of construction project estimates	9.9	12.3
planning-surveying work	0.8	0.6
Total	100.0	100.0

The above data show that the proportion of capital investments in renovation had significantly decreased by the end of the 10th Five-Year Plan, with simultaneous growth in the proportion of expenditures on retooling, while they remained nearly unchanged, at about 60 percent, for new construction and expansion. We intend to direct 10.1 percent of all capital investment in production construction into major overhauls and 19.1 percent into retooling and renovation in the 11th Five-Year Plan.

Increasing work output through replacement and renovation is being retarded by the tautness of the plans at existing enterprises, by rigid regulation of capacities, and by the lack of needed reserves, which restricts opportunities for economic maneuvering, and in particular, opportunities for stopping to replace or renovate individual technological lines, subassemblies or entire enterprises. This direction of production fixed assets renewal is characteristic basically of an extensive direction of expanded reproduction. As a result of long and intensive reinforcement of fixed assets in the national economy, the USSR has accumulated an enormous fleet of machinery and equipment, but an appreciable proportion of it is obsolete or obsolescent.

The criteria for renewing equipment are not limited to obsoleteness and depreciation. Evaluations of the technical level of machinery (technical aging) and the conformity of machinery to ecological requirements (ecological aging) and ergonomic requirements have also acquired important significance.

As a whole, the criteria cited are associated with the social evaluation of the consumption value of machinery and its dynamics.

Two main factors cause the updating of machinery due to technical aging: first, continuous expansion and updating of the assortment of output being produced; second, the necessity of ensuring, based on new machinery, a higher level of quality, the level which has become socially normal. In a number of instances,

this requires the replacement of equipment long before it becomes physically worn out. The scientific-technical revolution has led to the necessity of massive replacement of generations of machines which have exhausted their potential with ones possessing fundamentally new consumption characteristics and high efficiency. Under these conditions, the rates of equipment aging must accelerate significantly.

Factors connected with the conditions under which equipment is used also influence its renewal. The reference is foremost to the growing ergonomic demands on equipment, to the necessity of eliminating excessive noise, vibration, hard and monotonous labor. Fuller consideration of these demands is one of the factors in improving working conditions and labor productivity. In the 1980's, given the growing manpower deficit, the proportion of such machines as will need to be replaced prior to becoming obsolete or updated due to nonconformity with contemporary ergonomic demands is increasing.

The ecological aging of machinery is connected with the necessity of producing and using equipment which ensures the efficient use of natural resources and a reduction in environmental pollution. Recording the ecological factor when replacing equipment takes on special urgency when mineral, water and other natural resources become increasingly scarce and when hazardous discharges in certain regions reach levels at which disruptions of the natural process of biosphere replenishment are possible.

At the same time, the intensive path of production development is associated with big qualitative changes in the technical base of production. The development of social production is already characterized not so much by the rates of growth in fixed assets as by the degree of their updating and by structural changes.

The tasks of production intensification are being resolved by replacing machinery withdrawn [from production] due to wear or age with more economical models. The growth of a significant portion of simple reproduction based on expenditures into expanded reproduction based on end results (consumption value, social usefulness) is objective in nature and is emerging as a natural law of social production and a source of savings in expenditures and material resources, including metal, in the scientific-technical revolution.

The consolidated calculations given below, based on 1981 data, provide a reference picture of metal-output resources actually consumed to renew fixed assets through major overhauls and the replacement of production circulating capital.

Iron and steel machine and structure parts collected in the course of routine repairs and major overhauls and during machinery modernization and renovation are evaluated annually by the VNIPIlom [probably: All-Union Scrap Metal Research and Planning Institute] based on a generalization of annual reporting data obtained from approximately 5,000 enterprises producing ferrous metals, hardware and castings, forgings and stampings, as well as from those consuming at least 500 tons of ferrous metals per year. The remaining depreciation scrap based on the union-wide iron and scrap metal resources balance (1, p 200) is added to

that data. As a result, the depreciation scrap resources used (from routine repairs and major overhauls of fixed assets, their modernization and renovation) in 1981 was estimated to be 14.6 million tons. Metal in the form of machines and mechanisms withdrawn from production in the course of modernizing and renovating fixed assets is usually included, in enterprise reporting, in the depreciation scrap group under "Withdrawn due to elimination of fixed assets," but that particular group includes only the replaceable structural elements of fixed assets, which we estimate, based on the reproduction structure of capital investments, to be a maximum of 10-15 percent of the depreciation scrap of that group. Correspondingly, we estimate the depreciation scrap collected in the course of major overhauls and routine repairs to be 12.4 to 13.1 million tons. We estimate the under-collection of this type of metal from repair work done under field conditions, in pools, on subsurface structures, and so forth, including in part losses in shipment to plant and city dumps, at 20-25 percent (1). Consideration should also be given to the fact that the replaced elements of machinery and equipment involve metal losses of 8-9 percent due to abrasive wear and corrosion. Consequently, the initial weight of machinery and equipment elements and metal parts of other types of fixed assets replaced in 1981 was estimated to be 10.0 to 16.5 million tons.

In 1981, we collected 4.1 million tons of metal from the withdrawal of replaced equipment (ingot molds, shafts, dies, and so forth). Wear during operation was estimated at 3-5 percent. Consequently, the initial weight of that replaced equipment, for replacement purposes, was 4.2 to 4.3 million tons.

In 1981, we collected 455,000 tons of metal in the withdrawal of tools and tooling, with initial weight estimated at 500,000 tons considering tool wear and incomplete collection of that equipment being withdrawn.

Some 1.7 million tons of metal was collected in the withdrawal of minor production implements, nonproduction property and stock, and metal consumer goods of the populace. Undercollection of this metal is estimated at 40-50 percent (1). Consequently, reproduction of this type of metal goods requires about 2.8 to 3.4 million tons.

Thus, about 24.0 to 28.3 million tons of machinebuilding metal output was withdrawn from production in 1981 and an equal amount was used to maintain fixed assets in working condition and to rebuild circulating capital of the national economy and consumer goods. This metal output comprises about 30-35 percent of all machinebuilding and metalworking output, but only 65-70 percent was used to replace worn out or for expanded reproduction of fixed assets, including modernization and renovation, and to supplement the metal portion of circulating capital and household property of the populace.

The level of metal use in the manufacture of spare parts, replaceable equipment, tools and tooling, small stock items and property we take to be 0.65, given an average metal use level of 0.71 to 0.72 in the basic branches of machinebuilding and metalworking, with consideration of the nature of spare parts and other replaceable metal in the fixed assets and circulating capital of the national economy and the significant share their manufacture occupies in nonmachinebuilding branches. Consequently, the amount of metal output used for the indicated needs in 1981 was about 24.0 to 28.3 million tons: 0.65 = 36.9 - 43.5 million tons,

including 25.0 to 31.0 million tons for major overhauls on fixed assets. Thus, this level of operational metals-intensiveness "deflects" about 25-32 percent of the metal output volume being used in machinebuilding and metalworking production nationwide.

According to our research (2), economic losses of scrap metal in machinebuilding and metalworking are from 70 to 550 rubles per ton, depending on the nature of the billet production, and average about 1,500 to 2,500 rubles/ton as a result of the withdrawal and replacement of machine parts or subassemblies no longer in use (not counting economic losses from machine down time during repairs). In this connection, the task of lowering machinery operational metals-intensiveness is of the greatest economic importance.

In economic practice, major overhauls are made on fixed assets first due to uneven wear resistance of machine component elements, second due to limited opportunities for enterprises to acquire new fixed assets to replace obsolete and obsolescent ones, third because of an opportunity to combine major overhaul with effective modernization of fixed assets (expenditures on routine major overhaul and modernization are generally lower than expenditures necessary to acquire analogous new machines) and, finally, because the growth in prices for new equipment in many cases outstrips the increase in equipment productivity growth, leading to a reduction in the return on capital.

The problem of lowering the level of fixed assets operational metals-intensiveness is examined below, first as a function of design factors and second as a function of the state of fixed assets renewal through the replacement of depreciated and obsolete assets.

Given the high rates of scientific-technical progress and the dynamism of public demand, accelerating the circulation of material production resources is acquiring increasing importance. Slow production retooling and the unjustified use of machinery and equipment which is operable technically but which has become obsolete lead to high economic losses. The current schedules of obsoleteness [physical wear] and obsolescence for fixed production assets diverge substantially; assets are renewed slower than is necessary to actualize the latest achievements of science and engineering. In order to bring the reserves for intensifying the economy which exist in this area into play, we are faced with shifting the center of gravity from maintaining fixed assets in operating condition through repeated major overhauls to qualitative improvement in them, to retooling and modernization, which will permit significant acceleration of the renewal of production potential.

Depreciation deductions for major overhauls on fixed assets of the national economy were 31.7 billion rubles in 1981 (9) and were obviously close to actual expenditures although, as we know, some major overhaul funds are enlisted from depreciation deductions to renovate fixed assets.

In 1978, actual expenditures in USSR industry as a whole were 46.6 percent for routine maintenance and 53.4 percent for major overhaul. Therefore, 1981 expenditures on major overhauls and routine maintenance on fixed assets of the national economy are estimated at approximately 57-62 billion rubles, which is about five percent of the value of production fixed assets.

More than half the metalworking equipment available in non-machinebuilding branches, or about 44 percent (3) of all such equipment nationwide, and about a third of the equipment in machinebuilding branches which is available in auxiliary shops, comprising as a whole more than 50 percent of all metalworking equipment nationwide, is used for repairs. Upwards of 40 percent of the machine tool operators, forge workers and stamp operators and an even higher proportion of the lathe operators are associated with this part of metalworking equipment.

As the country's metal stocks and the share of the active portion of fixed production assets in them grow and as the design complexity of the machines increases in connection with the mechanization and automation of production processes and their intensification, expenditures on repairs to fixed assets increase faster than the growth in the overall amount of fixed assets (deductions for major overhauls to fixed assets in 1982 had increased correspondingly by 60.2 percent from 1975, given growth of 52.7 percent in the latter (4, pp 46, 519)).

This is a consequence of the inadequate level of reliability and repairability of the machines being produced, as well as of the significant lag in the rates of technical progress in repair, which is done primarily using intraplant resources rather than at specialized repair facilities, or, more commonly, by non-machinebuilding enterprises manufacturing a particular type of equipment.

According to USSR Central Statistical Administration data, the 1977 shift index at enterprises of USSR machinebuilding ministries averaged less than 1.36, in the RSFSR -- 1.35, and at machinebuilding enterprises of non-machinebuilding branches -- 1.14. A selective survey of shops and sectors at non-machinebuilding enterprises with metalworking equipment showed that the shift index there was below 0.3 to 0.5. In the latter group of enterprises, which has 42.5 percent of all RSFSR machine tools, output per unit of equipment generally does not exceed 4-8 percent, and labor productivity 20-40 percent, of the corresponding indicators for machinebuilding enterprises (5). The level of metalworking equipment concentration at machinebuilding enterprises of non-machinebuilding branches and machinebuilding workers is 15.4 to 12.4 percent of that of the former, and at non-machinebuilding enterprises -- 1.6 to 0.4 percent. Of the types of machinebuilding output and services performed by these two groups of enterprises, repairs and spare parts production comprise 48 percent (5).

Repair expenditures currently dominate in overall expenditures on simple reproduction of fixed assets, exceeding expenditures on replacing withdrawn assets, that is, on repeated rebuilding of obsolescent machinery and equipment as opposed to the introduction of progressive equipment. The value of withdrawn fixed assets in the national economy in 1982 was about 39 billion rubles, and the value of major overhauls and routine repairs was about 59-65 billion rubles, that is, 1.5- to 1.7-fold higher (4).

This high a level of expenditures on repairs results primarily from the failure to replace promptly physically worn-out means of labor and from the unsatisfactory state of repair production organization. Thus, the withdrawal of industry fixed assets due to dilapidation, wear and accident is only 1.1 to 1.5 percent annually (of fixed assets as of the start of the year), and a significant portion of that relates not to basic technological types of machinery and equipment,

but to auxiliary and general plant property (power equipment, transport and mechanical repair equipment).

The average age of withdrawn means of labor in 1979 was 33 years at the Zaporozhstal' Plant, 25 years at the Kuznetskiy Metallurgical Combine, 26 years at the Kherson Electrical Machinebuilding Plant, and 22.9 years at the Kolomenskiy Heavy-Duty Machine Tools Plant. Many industrial enterprises have high amounts of obsolescent equipment.

As a result of the failure to make replacements promptly, the average level of wear of fixed production assets in 1979 was more than 40 percent at 19 of 30 enterprises surveyed in the USSR Ministry of Ferrous Metallurgy, at 5 of 10 in the USSR Ministry of Electrical Equipment Industry and at 4 of 15 in the USSR Ministry of Building Materials Industry (6).

Given the long development in the past of primarily the extensive direction, the bulk of the new means of labor received by industry was used to expand the production apparatus.

Moreover, production outlays to repair machinery and equipment have been extraordinary, a result in some measure of the high degree of dispersion of the repairs and of the low technical level of the equipment used for repairs. Thus, automotive transport is repaired by at least 2,000 enterprises affiliated with more than 40 ministries and departments; agricultural machinery is repaired by more than 2,000 enterprises; approximately 2,200 enterprises, workshops and other shops repair construction and road machinery. The proportion of centrally obtained spare parts at, for example, ferrous metallurgy enterprises of the UkrSSR fluctuates between 5 and 10 percent, in coal industry -- 12-15 percent, in chemical industry -- 25-35 percent, and the remaining and bulk of the spare parts are manufactured by enterprises of those branches. As a result of the unsuitability of many enterprises to manufacture spare parts and make major overhauls on machinery and equipment, expenditures on repairs over their service life significantly exceed expenditures on their production. For example, overall expenditures on maintaining tractors used in agriculture and excavators used in construction in operating condition are approximately 2.5 times higher than their initial cost, and expenditures on repairing trucks used in agriculture are even higher.

The data adduced do not take into account the economic losses due to machinery and equipment down time during repairs. Thus, in the construction industry, an average of about 20 percent of the capacity of all basic machinery is not used for 40 to 60 days due to down time for repairs to various types of equipment. Thus, modern rolling mills stand idle for repairs 12-16 percent of each calendar year, or 1,050 to 1,450 hours. And even in hypothetically constant expenditures, an hour of down time for a blooming mill costs 450 rubles; about 15 million rubles a year is lost due to down time for existing blooming mills here (7, p 66).

The inadequate quality of repairs at small enterprises and workshops significantly lowers the average operating time of machinery between major overhauls as compared to new machines; expenditures on technical servicing, routine and unplanned repairs after major overhaul increase by 20-30 percent. Even when

major overhauls are done at large, specialized enterprises, the average operating time is 15-20 percent below that of a new machine.

The basic reason for the frequent repairs to machinery and equipment is the inadequate use of stainless steel and nonferrous metals in the manufacture of parts subject to accelerated wear from corrosion. The share of such metals in the structural materials being used in USSR machinebuilding is extremely inadequate.

Of important significance to increasing the between-repairs service life of machinery and equipment elements is their design, which must anticipate a reduction in the differences in operating service life for the various elements of machines both by improving their fit and by using more wear-resistant types of metal and brands of steel for these elements.

As machinery subassemblies approach equal strength, the need for major overhauls will objectively decrease. In the ideal case, given the achievement of equal or very close service life for machinery units and subassemblies, the demand for major overhauls drops, leaving the task of lowering obsolescence through the modernization and renovation of fixed assets.

The time machines spend in repair and expenditures on those repairs, including specific metal expenditure, depend in considerable measure on the adaptability of machine designs to the detection and elimination of malfunctions, as well as to restoring operability. This adaptability is embodied in the machine property called repairability (repair technological effectiveness).

Improving machinery and equipment repairability in the course of design and modernization is an important source of saving metal and lowering operational metals-intensiveness. The better provision of machinebuilding with nonferrous metals for manufacturing machinery elements subject to the most intensive wear is also of important significance. The same also applies to the more extensive use of plastics and powder-metallurgy materials to coat the surfaces of individual machinery mechanism elements.

The changeover from reproducing assets on an old technical basis to modernizing existing capacities to reflect a number of technical innovations is a pressing task. In particular, it is necessary that the production capacities available for major overhauls be switched over to modernizing and updating the fixed assets of existing production, using retooling for these purposes.

The economic importance of combining major overhaul with modernization is very great, especially as applicable to machinery and equipment with a long service life. This applies to metallurgical, chemical, power and other equipment. As experience shows, the increase in machinery and equipment productivity as a result of modernization can reach significant amounts with relatively low expenditures. Thus, in ferrous metallurgy, blast furnaces and rolling mills are regularly renovated. In 1971-1979, the increment in blast furnace capacity as a result of renovation through capital construction, major overhaul and the production development fund was more than 3.3 million tons; the increment in slabbing mill capacity at the Magnitogorsk Metallurgical Combine was 2.1 million tons, at blooming mill No 2 -- 4.3 million tons, blooming mill No 3 -- 520,000 tons, the large-sections mill -- 47,000 tons, the hot-rolled sheet mill -- 427,000 tons,

and the cold-rolled sheet mill -- 91,000 tons (8). At a number of metallurgical enterprises, retooling of the production apparatus has for many years been done primarily by repair services following the principle of "not a single major overhaul without equipment modernization and renovation."

Thus, the Cherepovetskiy Metallurgical Plant alone renovated nearly all its blast furnaces during the 10th Five-Year Plan, and two of those provided more than a 330,000 ton per year increment in annual pig iron production. Output was increased by renovating nearly a third of all plant agglomeration machines and half of all open-hearth furnaces. Renovation of technological equipment in the merchant shapes shop on a progressive basis provided a metal savings of approximately 250,000 tons, with an overall economic impact from introducing modernized rolling mills of 60 million rubles. The same things were done at other metallurgical plants as well (8). At a number of electric power plants, major overhauls were combined with an increase in turbine unit power and at chemical enterprises -- with an increase in the capacity of basic units.

Little is actually being done to modernize equipment by the enterprises and associations manufacturing it. In this connection, foreign experience in buying and selling used producer-firm equipment after modernization merits attention. These companies gladly purchase or accept for modernization machinery previously manufactured by them or restore the initial parameters of such equipment or bring them up to the level of the latest models. This raises the technical level of equipment modernization and improves its operation correspondingly, providing a large savings in metal and a reduction in other expenditures.

Centralizing repair services within production associations is also highly effective.

Thus, for example, the Leningrad Mechanical Optics Association (LOMO) replaced four mechanical repair shops with one large shop specialized for major overhauls to technological equipment and lift-transport devices. This enabled it to establish uniformity of repair methods and to shorten repair time. As a result, repair costs dropped by 35 percent. This same association specialized three multipurpose tool shops, resulting in a 25-percent drop in the net cost of their output. An appreciable savings in metal was thus achieved in tool repairs and production.

The capacities of repair organizations created in many branches of the national economy and industry should be used correctly as part of the investment complex or in conjunction with it. They have large reserves and are well-equipped in a number of branches of industry (for example, ferrous metallurgy, petrochemical industry and others). Enterprise modernization by territorial general construction organizations is not always effective, inasmuch as these organizations do not have work experience under the constrained conditions of an operating production facility. To the contrary, it is the departmentally-subordinated repair-construction organizations which are familiar with work under those conditions. In this connection, the plans of the investment complex should also take into consideration the opportunities of the repair organizations, but within the framework of updating the production apparatus already in operation.

Today, a huge percentage of the metal-cutting machine tools is committed to manufacturing spare parts, the deficit in which is, however, becoming increasingly critical. In order to solve the problem, we should switch from small repair production facilities to the creation of a specialized repair and restoration industry. The repair industry offers great opportunities for raising the level of rebuilding work, for making better use of the equipment, technology and technical means in use in basic machinebuilding production.

We have experience in this. For example, the Volga Automotive Plant has successfully mastered the rebuilding of worn automobile subassemblies and units using industrial technology. This process has also been set up in the base mechanical repair shops of the union ministries of chemical and petroleum, tractor and agricultural machinebuilding. The all-union association for repairing machine tools and producing spare parts for them has been in operation successfully in machine-tool manufacturing and tool industry for several years now.

Intrabranch centralization, concentration and specialization provide an opportunity to reduce expenditures on spare parts manufacture and improve their quality. The next stage might be to convert the base plants and shops existing in the economic regions from departmental to regional ones so as to set up, on their basis, the rebuilding of machinery, machine tools and equipment independently of what ministry's enterprises they belong to. In view of the size of the country and its degree of industrialization, it is not difficult to convince oneself of the economic benefits of organizing repairs by plants of the branches producing a particular products list of machinery, as well as by large regional enterprises, in particular, for repairing machinery withdrawn from production.

The volume of production of new machines and spare parts for them and the volumes of major overhauls on these machines, their units and subassemblies are closely connected with each other and depend on the overall duration of the life cycle of a given type of machine. But in the practice which has evolved, the producers of machines turn out to be associated with only one part of the life cycle of the machine (technical planning, design development, production of the machine and a very brief warranty period for the machine in operation) and are entirely separate from the other important part (operation, major overhaul, maintenance of initial productivity, elimination as a result of obsoleteness and obsolescence), which does not meet the demands of improving the effectiveness of social production.

However, it should be borne in mind that the country's enterprises have a very significant proportion of machinery and equipment which is no longer being produced by machinebuilding. In this instance, the needed spare parts and subassemblies must be manufactured by specialized repair enterprises or associations. This form of spare parts production organization is to an extent already finding practical application in industry and is yielding a large economic impact. For example, plants of the "Soyuzstankoremont" all-union association manufacture upwards of 3,000 different spare parts. Spare parts production is set up in large lots on adjustable flow lines. As a result, a significant savings in metal and improvement in the quality of spare parts has been achieved. This leading experience should also be introduced in other branches of industry.

The CPSU 26th Congress decree noted the necessity of "continuing expansion of the specialization of machinebuilding production and the creation of new and development of existing specialized enterprises and large shops manufacturing blanks, parts, subassemblies and units for branch and interbranch use."

Practical resolution of this task requires corresponding capital investments and time. In view of the uneven nature of the demand for repair work in different enterprises of the branches of industry and the national economy over the course of the year. we need a reserve capacity for immediate satisfaction of the demand for parts and subassemblies. This requires additional capital investments, but they would be quickly recompensed, the more so since non-machinebuilding enterprises have by no means ideal conditions for manufacturing spare parts themselves.

The creation of specialized, well-equipped enterprises for rebuilding worn parts permits high rebuilding quality and low net cost. Highly effective methods are used to rebuild many worn parts at specialized enterprises: electric arc flux and inert-gas smelting, cold-welding iron using composite electrodes; epoxying cracks; chroming, steeling, metallization, plastic deformation. The use of X-rays, gamma-ray defectoscopy, ultrasound and other advanced equipment to check parts from machines being repaired provides an opportunity for objective diagnosing. Practice at the leading repair enterprises confirms that machines repaired with consideration of all technological requirements and operated following technical servicing rules have a service life to the next major overhaul approximately equal to that of new machines. Unfortunately, consumers of the machines lack opportunities to use the enumerated methods of rebuilding when doing the bulk of the major overhauls. This necessitates the continued use of machines with worn subassemblies and parts, leading to more frequent and more complicated repairs.

Studies have established that the average percentage of all parts being repaired which is suitable for restoration is less than 40 percent. The net cost of rebuilding worn parts for metalworking equipment, for example, is 3-10 times less than expenditures on manufacturing new parts; the figure is 2.5-3.3 times less for automobiles. The demand for new spare parts thus decreases correspondingly when worn parts are rebuilt.

An increasing proportion of the machine tools being produced obviously need to be sent in for replacement of obsolete and worn parts: as against the approximately 1.5 to 2.0 percent of the machine tools currently being withdrawn from use, 3-4 percent of the more productive machine tools must be replaced annually, 5-6 percent later, which leads to a reduction in the available machines as their unit production capacity grows.

In spite of the significant growth in the release and introduction of new equipment, no trend has yet been observed towards accelerating the withdrawal of old machines. The average annual proportion of the active portion of fixed production assets of USSR industry actually withdrawn was 2.42 percent in the 7th Five-Year Plan, 3.16 percent in the 8th, 2.48 percent in the 9th and 2.30 percent in the 10th (4, 9).

The indicated amounts of average annual equipment withdrawal do not ensure a reduction in actual service life to normative levels. Proceeding from the necessity of accelerating the updating of fixed assets, the depreciation deduction norms introduced in 1975 anticipate shorter service life periods: average industry fixed production assets normative service life periods have been reduced from 25.6 to 21.3 years, and for construction -- from 13.3 to 12.4 years. The average normative service life periods for machinery and equipment were reduced even more, from 17.3 to 14.5 years in industry and from 10.9 to 8.3 years in construction. However, the actual service life periods for machinery and equipment in industry are considerably longer.

At the same time, the most effective updating variant presupposes a coincidence of the machinery and equipment replacement periodicity with the rate of technical progress, inasmuch as equipment which is both physically worn out and obsolescent would then be replaced with more productive units. Consequently, accelerating this replacement process is an important demand of industrial equipment updating policy (and an important element of technical policy).

Centralized repair of the active portion of fixed assets could yield a 20-30 percent savings in metal, an actual 6-8 million tons of metal products per year.

The CPSU Central Committee and USSR Council of Ministers Decree "On Perfecting Economic Interrelationships Between Agriculture and Other Branches of the National Economy" anticipates that when tractor, automobiles, agricultural machinery and equipment malfunction due to the fault of the manufacturing enterprise within the warranty period, repair expenditures will be reimbursed by the manufacturing enterprise. Moreover, these enterprises reimburse losses due to down time above the established periods for tractors, automobiles, agricultural machinery and equipment if the manufacturing enterprises fail to meet their obligations to ship spare parts to reserve stocks for warranty repairs.

This procedure for machinebuilder material responsibility to consumers of their products should obviously be extended in the future to other types of machinery and equipment being manufactured, with consideration of their features.

The next important source of metal savings is to reduce the operational metals-intensiveness of fixed assets as a result of the replacement of physically worn and obsolescent units with newer and less metals-intensive ones. As experience has shown, during the average service life of machinery and equipment (approximately 20 years), the machinery and equipment being manufactured changes nearly two times, new machine systems are developed, automated and cybernetic devices are introduced, the unit power of machines grows, better-quality metals and metal substitutes are used, and design calculation methods are improved. In this connection, the metals-intensiveness of machinery and equipment drops steadily. This is expressed in higher rates of growth for machinebuilding output as compared with metal consumption. A metal savings is achieved as a result of the replacement of machines in use with new ones.

It should be noted, however, that these opportunities are still not being used satisfactorily. They should therefore be intensified in the future.

Proceeding from the task of ensuring intensive updating of production fixed assets in conformity with the rates of technical progress, it would be appropriate in our view to ensure the following acceleration of their average annual withdrawal over the next three to four five-year plans (in percentages of the value of the fixed assets): for processing industry -- 4.0 percent (instead of the 1.1 percent during 1980), extractive industry -- 4.0 percent (instead of 3 percent), transport and communications -- 3.0 percent (instead of 0.9 percent), construction -- 4.0 percent (instead of 3 percent), agriculture -- 4.0 percent (instead of 3 percent), trade and other production fixed assets -- 2.0 percent (instead of 0.5 percent), and for material production on average -- 3.8 percent (instead of 4.7 percent).

The norms for withdrawing fixed assets in agriculture and construction are close to the actual levels in view of the fact that physical wear predominates at present due to the unsatisfactory use and storage of agricultural and construction machinery and implements. In the future, a leading place will belong to obsolescence, through the elimination of these factors.

In connection with the accelerated withdrawal of physically worn out and of obsolescent and technically and ecologically obsolete fixed production assets, we will necessarily and naturally reduce the demand for major overhauls to fixed assets a minimum of 2.5-fold.

At present, about 16.5 to 20.0 million tons of spare parts are used in routine maintenance and major overhauls on fixed assets of the national economy, with about 15-18 million tons in major overhauls. Given a 2.5-fold reduction in the amount of major overhauls on fixed assets of the national economy, the demand for spare parts would decrease by 10-12 million tons a year.

Thus, the machinebuilding capacities freed for other uses by a reduction in the demand for spare parts could be used to accelerate the replacement of withdrawn fixed assets. Were this to be done, a machinebuilding production capacity would remain, first in connection with the anticipated reduction in the level of machinery and equipment metals-intensiveness in new model designs, and second in connection with the anticipated relative technological savings in metal in the procurement cycle of machinebuilding.

The policy of intensive updating of production fixed assets is a complex, long-term economic process, inasmuch as such replacement must be accompanied by the attainment of optimum enterprise capacity and intensified enterprise specialization, by ensuring correspondence of capacities among the individual production links within enterprises in terms of their provision with progressive new types of machinery and equipment. The replacement of existing machinery and equipment with new units in the consumer branches must generally be done at the previous location of withdrawn units. But, inasmuch as these types of machinery and equipment are also used outside the specialized branch (as, for example, rolling mills at machinebuilding enterprises comprising so-called small-scale metallurgy), they must be installed within the branch when these types of machinery and equipment are eliminated in other branches. As concerns general-purpose machinery and equipment (metalworking, woodworking, foundry, road construction and so forth), they must, as a rule, be installed in specialized branches of industry when corresponding existing types of machinery and equipment are eliminated

in the remaining branches where their use has given rise to an effort by enterprises to achieve economic autarchy.

Practical actualization of the intensive updating of production fixed assets along the indicated line requires the corresponding development of specialized repair enterprises, the organization of sponsorship repair, modernization and renovation at corresponding machinebuilding enterprises. As concerns large enterprises with a continuous production cycle for which it is appropriate to retain independence in performing major overhauls, they should be provided with spare parts from outside.

The actual provision of enterprises and farms with appropriate repair service, prompt and high-quality modernization and renovation of fixed assets, will enable us to eliminate huge numbers of machines and equipment of corresponding purpose in the numerous non-machinebuilding enterprises and on farms and to obtain a significant savings in expenditures, including at least 6-8 million tons of metal a year.

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CSO: 1823/81

MINISTRY COLLEGIUM NOTES LAGGING TECHNOLOGICAL PROGRESS

Leningrad LENINGRADSKAYA PRAVDA in Russian 19 Jan 85 p 1

[Text] An expanded meeting of the Ministry of the Machine Tool Building and Tool Industry collegium and of the presidium of the Central Committee of the machine tool and instrument building workers' trade union took place on 18 January.

B. V. Bal'mont, minister of the machine tool building and tool industry, gave a report on results of the industry's work in 1984 and measures for ensuring the fulfillment of its plan for 1985 in the light of demands of the Central Committee of the Communist Party of the Soviet Union (TSK KPSS) and instructions and recommendations of Comrade K. U. Chernenko.

The work of the ministry and its production associations, enterprises and scientific research and design organizations was thoroughly examined at the meeting. It was noted that along with certain successes, there are still a considerable number of shortcomings in the industry's work, and that results which have been achieved do not entirely meet the requirements of technological progress at its present stage. The ministry is not fully utilizing its potential for accelerating the retooling and intensification of machine building industry and the supplying of highly effective metalworking equipment and tools for the economy.

Ways were defined for fulfilling plan assignments for the final year of the 5-year plan, as well as measures for improving the work of all of the industry's organizations, improving the structure of management, specializing industry still further, and strengthening its ties with science.

G. V. Romanov, member of the Politburo and secretary of TSK KPSS, spoke at the meeting.

CSO: 1823/111

INDUSTRY PLANNING AND ECONOMICS

UDC 621.757:658.5.011.56.001.33

POTENTIAL IMPLEMENTATION OF ADVANCED TECHNOLOGY SURVEYED

Moscow MASHINOSTROITEL' in Russian No 8, Aug 84 pp 30-31

[Article by Candidate of Technical Sciences A. A. Panov under the heading "To Assist the Technologist and Designer": "Technological Features of Improving Mechanical Assembly"]

[Text] When outlining the main ways of improving mechanical assembly technology, we need to take into account the objective conditions of contemporary machine tool manufacturing development:

-- systematic improvement in the precision of the machine tools being produced and consequent improvement in the dimensional and geometric precision of a number of machine-tool parts;

-- improvement in the technical level and degree of automation of the machine tools being produced, increasingly complex designs, increasing numbers of parts to be machined, and increased labor intensiveness of machining and mechanical assembly;

-- provision of machine tools with various subassemblies based on electronics, including programmed-control systems whose technical level and quality influence the stability of operation of the machine tool;

-- constant reduction in the labor resources reserve, and in particular in the numbers of basic machine tool operators, assembly lathe operators, painters and workers in other categories.

At the same time, we need to take into account several trends and directions in the development and improvement of mechanical assembly technology in machine tool manufacturing:

-- introduction of "limited-operations" machining technology, or the maximum possible concentration of technological operations to be performed at a single machine tool, to the extent possible with a single positioning of the part; this direction is effective for practically all types of production;

-- maximum intensification of machining processes based on the use of parallel and parallel-sequential methods of machining, including covering by machine time that time spent placing and removing the part; accelerating cutting by using new tool materials (hard-alloy blades with wear-resistant coatings) and tools using superhard materials (STM) and mineral-ceramics;

-- increasing the degree of machining "finish" by eliminating the "completing" operations done during assembly. It is effective to "shift" labor intensiveness from assembly to machining processes and from there to blank production.

What actually happens is that large capital investments are made in raising the level of machining, but the level of blank production rises slowly, so the metal use factor does not improve;

-- improving the labor intensiveness of assembly operations and electrical assembly in association with the increasing complexity of machine tool designs and also that of work to interface them with NPC systems. Mechanizing assembly operations (subassembly mounting, general assembly, test-stand testing of the assembled machine tool) is a primary task in the development of assembly technology. The robotization of a number of technological operations through development of a new generation of industrial robots is a promising development in assembly production.

We intend to improve labor productivity, improve the quality of the output being produced and raise the technical level of mechanical assembly on the basis of developing progressive technology, of mechanizing and automating production processes. Introduction of a number of low-waste technological processes involved in blank production will ensure improvement in methods of obtaining blanks which are then machines and improvement in the metal use factor (as the production of iron castings smelted in induction furnaces and modern cupolas with hot forced air and manufacturing blanks by powder metallurgy increase). The production of duplex-process iron castings on automatic lines, in chill molds, using centrifuge and other methods, will be increased significantly. In order to lower equipment metals-intensiveness, we intend to increase the production of welded metal components.

Definite steps are being planned to improve forging-stamping production, including shaping blanks for stamping and precision cutting of blanks using curved blades and presses, and also the development of comprehensively mechanized forging and stamping production.

Questions of intensifying technological processes based on the use of new tool materials and abrasives, of tools made of STM's such as el'bor [a borazon material], polycrystalline diamonds, and so on, occupy a significant place. We anticipate expanding the field of application of multiface hard-alloy blades with wear-resistant coatings (such as titanium carbide) and blades made of mineral ceramics.

We intend to intensify grinding operations on the basis of high-speed external disk grinders (disk speed $v_{kr} = 50$ m/sec), as well as internal and flat-bed disk grinders ($v_{kr} = 60$ m/sec).

We intend to expand the field of application of a number of progressive technological processes associated with the introduction of new equipment, and in particular, belt cutoff machines, specialized semiautomatic frontal-type machines for turning flanges, special and unit machine tools, installations for electroerosion, electrochemical and ultrasonic processes, automatic and semiautomatic machine tools to replace multipurpose ones, and NPC machine tools, including multiple-operation ones.

We anticipate the organization and introduction of fully automated sectors using NPC machine tools computer controlled to machine body and rotating parts, as well as automated sectors for cutting blanks. The sphere of application of highly

effective automated technological complexes including NPC machine tools and automatic transport-storage systems will be considerably expanded.

Expanding the sphere of application of industrial robots is a relatively new direction in the area of automating machining. We intend to introduce complexes of the "machine tool - robot - bin" type.

Improving the technological structure of the machine tools in machine shops is an important indicator of improvement in machining technology. We intend to increase the proportion of progressive groups of equipment in the machine tool fleet, including automatic and semiautomatic machine tools (excluding special machine tools), NPC machine tools, special, specialized and unit machine tools, and high- and very-high precision machine tools. These new machines include two-spindle frontal lathes with cyclic programmed control, NPC lathes equipped with an automated movable stay and tailstock for external and internal turning of spindle-type parts at a single setting, moderate- and high-precision (using active monitoring and NPC) cylinder-and-cone grinders and facing circular grinders for operation at $v_{kr} = 50$ m/sec, semiautomatic moderate-precision (using active monitoring) internal grinders for operation at $v_{kr} = 60$ m/xec, and transverse milling-lapping machines (using instrument readings and a carrier stock) for machining base and body parts using a blade made of STM.

We intend to introduce flow and mechanized-flow lines, mechanized rotatable stands, hydraulic and pneumatic presses, and road-test monitoring and test stands, including ones equipped with technical diagnostic systems. We anticipate mastering the production of equipment for assembling tension connectors, including heating and cooling installations, drying cabinets, baths and other assembly equipment. We will be expanding the use of progressive technological processes for connecting parts using fast-drying glues.

In view of the growing complexity and labor intensiveness of electrical assembly work, we plan to introduce widely equipment for electrical assembly work.

We have outlined the introduction of normative-technical documentation for scientific research and experimentation in the field of machining and assembly technology. It encompasses the technological processes for working standard machine tool parts (beds, spindles, bushings and tail spindles, 5th-6th degree of precision gears, and others) for small- and medium-series production. A series of guidance materials includes the most important technological processes of assembly work, including alignment during the assembly of subassemblies and high- and very-high precision machine tools, the assembly of NPC machine-tool servo drives, general assembly and testing of high- and very-high precision machine tools, and the testing and monitoring of assembled subassemblies for those machine tools. We also plan to introduce standard plans for sectors to adjust tools outside the machine tool and assembly shops.

With a view towards developing mechanical assembly production technology, large-scale scientific research and experimental work is being done to develop new tool materials and abrasives, progressive cutting tools made of STM, mineral ceramics and hard alloys with wear-resistant coatings for machining the parts of bodies and rotating parts; in particular, this means blade-type tools ensuring a 1.5- to two-fold improvement in labor productivity.

Scientific research aimed at developing high-speed grinding anticipates a set of new grinding disk characteristics and grinding procedures for parts such as spindles and tail spindles (given $v_{kr} = 50...60$ m/sec): external -- on base bevels, internal -- openings in spindles, fastener threads, centering holes. Labor productivity would increase 1.5- to two-fold. Experimental work is being done to determine optimum grinding routines for various steel and iron parts, including the grinding of housing surfaces (flat) on shaper-grinders ($v_{kr} = 50$ meters per second).

With a view towards increasing cutting tool life, we have outlined scientific research and experimental work to select a water-free cutting fluid, on hardening tools in a magnetic field, in "Bulat" devices or by electric spark, on ion nitriding, vibroabrasion and so on. We plan scientific research on creating a branch system for developing technological processes based on a unified computer system which would permit a three- to five-fold reduction in the production technological preparation cycle. We anticipate scientific research and experimental work to choose types of plastics and develop technologies for applying them to guide machine tools, thus reducing the use of manual labor to scrape guides, reducing the labor intensiveness of assembly work and improving the quality of machine tools.

A complex of scientific research and experimental work on developing methods of evaluating the quality of assembly of domestic subassemblies, including NPC machine tools, by using diagnostic equipment is aimed at improving the quality of subassemblies and reducing subassembly adjustment and run-in time after assembly. We intend to develop standard plans for fully mechanized sectors to assembly machine-tool subassemblies.

We anticipate scientific research and experimental work on choosing regenerable, nonflammable and nontoxic liquids to replace gasoline, kerosine and white spirit for use in washing out machine-tool subassemblies.

Great difficulties arise when automating discrete technological processes characteristic of machinebuilding. The first stage in this work is automation of mass production based on synchronous automatic lines. Resolution of this problem is accompanied by great difficulties connected with the fact that discrete processes are characterized by a large number of operations and different variants of item positioning, technological processing taking only five percent of the total time the item is in the production facility. The optimality of discrete technological processes is ensured by using computers to process large amounts of data in brief time intervals. A high level of technological structure automation is achieved with a new synthesis of these structures, a basic indication of which is the organic grouping into new systems of such types of technology as changing the state of the objects of production technological preparation, manipulating objects during technological processing, and organizing human activity to obtain data and for control.

Optimization of production processes under development is associated with the extensive use of mathematical methods. Thus, the use of linear programming to optimize cutout charts permits a 40-60 percent reduction in material scrap; the warehousing theory when used to plan interoperation stocks reduced inventory by 70-90 percent; group services reduces automatic line down time by 20-50 percent. However, the rapid development of mathematical methods is possible only if computers are used.

The ways of improving mechanical assembly technology include retooling, renovation and expansion of existing mechanical assembly shops; creation of automated, computer-controlled processing sectors; introduction of industrial robots, NPC machine tools, special, unit and specialized machine tools, automatic and semiautomatic machine tools, high- and very-high precision machine tools and robotized technological complexes; creation of sets of automatic, semiautomatic, mechanized flow lines and fully mechanized processing sectors; improvement in the technological structure of progressive groups of automated metalcutting equipment in the machine shops of basic production; introduction of progressive technology, mechanization and automation of production processes; complementing enterprises with highly productive unitized and adjustable tooling; organizing the centralized production of subassemblies and parts; increasing production volumes at existing centralized production facilities for normalized subassemblies and parts used in machine tools and machinery and in their repair. All this will enable enterprises to raise the technical level and quality of the equipment being produced and to lower the labor intensiveness and net cost of its manufacture.

11052
CSO: 1823/76

ADVANCED MACHINE TOOLS IN MODERNIZATION OF URAL PLANTS

Moscow EKONOMICHESKAYA GAZETA in Russian No 6, Feb 85 p 10

[Article by N. Gerasimov and M. Makhlin, EKONOMICHESKAYA GAZETA correspondents: "Initiative Taken by Enterprises of the Southern Urals"]

[Text] Toward the 27th Congress of the CPSU. Five-Year Industrial Intensification Plans.

On the initiative of labor collectives, a group of heavy-industry and machine-building enterprises of the Southern Urals laid down basic guidelines for accelerating development under the 12th Five-Year Plan by implementing new techniques and technologies and improving labor and production organization.

In cooperation with scientists and designers, each collective outlined realistic ways to achieve specific goals. The general task was stated clearly: Considerably increase the output of high-efficiency production required by the national economy and simultaneously reduce personnel. Increase labor productivity by a factor of at least 1.5.

Discussion at the working meeting for managers and leading specialists of a number of enterprises and associations of Chelyabinsk Oblast which was organized by the oblast party committee and the editors of EKONOMICHESKAYA GAZETA centered on a search for solutions and their implementation.

By their own admission, participants at the meeting agreed that increase in production in their area was linked to the hiring of additional workers, and complaints about labor shortages were taken for granted. The accepted procedure was to attract additional workers from the villages and woo others from the construction, transportation and non-productive sectors with factory benefits. Now industry in the oblast must adjust to acquiring its labor force from other sectors.

It is still too early to talk about overcoming all the so-called psychological barriers and bureaucratic snarls. But they are already giving way in area after area, under the confident innovative onslaught directed by the oblast party organization. This is apparent in the engineering and economic calcula-

tions of programs formulated by enterprises, by growing ministerial support of local initiative and the attention given to proposals made by people from Chelyabinsk in the USSR State Planning Committee.

E.A. Ostanin, director of the Chelyabinsk Automated-Machine Plant, gave a typical example at the meeting. Over a four-year period during the 11th Five-Year Plan, production volume increased by 40 percent and labor productivity increased by 45 percent. This released 300 employees. The industrial intensification output Year Plan sets the following guidelines for 1990: increase production output by a factor of 1.7, double labor productivity and reduce personnel by 1500 employees.

Now to hear from the participants at the working meeting.

BASE AND FACTORS OF GROWTH

Yu.F. Blinov, first assistant to the general director of Development and Technical Re-Tooling at the Chelyabinsk Pipe Rolling Association imeni V.I. Lenin (ChTZ):

Based on the specialists' first drafts, production volume at the ChTZ will increase by a factor of 1.5 in the next Five-Year Plan while the number of tractor assembly workers will decrease by 12,500. Of the entire program for intensifying production through utilization of the latest scientific and technical advances, nine basic trends stand out:

Radical changes in founding, forging and pressing, heat-treating and metalworking equipment and its structural organization;

Implementation of progressive, cost-effective, labor-efficient and energy-saving processes in all technological areas;

Development and implementation of flexible automated production systems, robotized production lines and facilities, automated lines, utilization of "work center" lathes and numerically controlled equipment;

Improvement of blank precision, reduction of allowances and mechanical work, increasing the coefficient of metal use;

Automation and robotization of basic technical areas in blank production, especially in areas which now require heavy manual labor;

Development and implementation of robotized welding units and lines and wide utilization of all-purpose welding robots;

Automation of production design and control processes and improvement of the control structure of the association;

Development of engineering services (tools and technological equipment, in-house machine building and facilities for automating and robotizing production);

Development of a modern repair and power-supply base for the association and a transfer and warehousing system.

It is no exaggeration to say that the entire collective participated in formulating the program. Plant management simply could not have managed this project. Areas where efficiency could be improved and the potential for automating and utilizing progressive technologies were analyzed by every shop, division and brigade. Never before have our specialists examined leading domestic and foreign options as intensely and productively.

A.A. Vorob'ev, director of the Chelyabinsk Tractor-Trailer Machine Building Plant:

The industrial intensification Five-Year Plan envisions increasing production by 25 percent and simultaneously reducing the labor force by 35 percent in the 12th Five-Year Plan.

In the next five years, we intend to place in service 14 automated lines, 36 robotized machining units, 81 numerically controlled lathes and 166 robot manipulators. At the same time, a transition will be made to the production of updated designs which utilize higher technology and are less labor intensive. This will require, and in fact is already requiring, organizational restructuring. The plant has seen the creation of a hydraulic laboratory and a department for automating production with its own robotization group. A repair group has been staffed with electrical engineers. We are setting up a subdivision to repair numerically controlled lathes.

B.V. Rashkovsky, Chief Engineer of the Polet Association:

In the 12th Five-Year Plan, we propose placing in service three automated shops based on flexible technological processes for mechanical work, electroplating and cold stamping. Radically new, virtually unmanned production processes will be implemented within these walls. Not only will the basic processes be automated, but also the transfer/warehousing system and the organizational and financial administration of the shops. In addition, flexible technological processes will begin to be implemented in departments in other subdivisions.

We figure to double labor productivity compared to 1985 levels. We will be able to increase production volumes by at least 12.5 percent annually and reduce the number of employees by 10 percent in five years.

Productive contacts with scientists from the Chelyabinsk Polytechnical Institute deserve special mention. Joint scientific and technical advice from the Institute and Polet representatives is shaping and evaluating work status and trends in the area of robotized automation and technological advances.

V.F. Sarychev, Director of the Technical Department at the Magnitogorsk Metallurgical Combine:

The 12th Five-Year Plan will be the first stage of implementation of a long-term program of technical re-tooling and renovation of basic equipment pools at the Combine. In contrast with machine builders, metallurgists are not in a position to replace equipment quickly. A lathe is one thing, but an open-hearth furnace or a rolling mill is another matter.

It has been decided that the open-hearth method of founding steel will no longer be employed at the Combine in the future. In the next 5 years, instead

of slag dumps, there will be a converter shop with three 350-metric-ton units equipped with continuous slab machines. The 2500 and 1450 model hot-rolling lathes must be rebuilt for adaptation to the continuous slab method before it can be placed in service.

The opening of the first converter shop will make it possible to retire Open-Hearth Shop No. 1 from service and reduce production at two others. Then a second converter shop will be built on the site of Open-Hearth Furnace No. 1, and the Combine will close all remaining open-hearth furnaces.

DEPEND ON SUBCONTRACTORS BUT PULL YOUR OWN WEIGHT

It happens at times that for a number of reasons, an enterprise is not able to increase production quickly, and sometimes there is simply no economic need to do so.

Such is the case at the Chelyabinsk Forging and Pressing Plant, where the current level of parts production is sufficient for the automotive industry. But the 12th Five-Year Plan will literally transform the enterprise. N.I. Bovenko, director of the forging and pressing plant, discussed this at the meeting. With the assistance of the Ministry of the Automotive Industry, the enterprise will make required equipment in house and be equipped with high-productivity lines.

All the participants at the working meeting remarked on the need to develop in-house tool cribs, shops and sections for non-standard equipment and machine building. Discussion turned not on de-specialization or the value of "natural economies," but on the objective full-fledged need on the part of the so-called service industries for a greater role. The ChTZ had already become aware of the negative consequences of underestimating such services. The Ministry has to be approached and a manufacturer found for many devices, even the simplest apparatus. It turned out that that enormous organization produced less of its own equipment than the forging and pressing plant. In the 12th Five-Year Plan, tractor assembly workers intend to increase the area of the in-house machine building shop 2.5 times and increase the output of non-standard equipment 1.5 times, including metal-cutting and metallurgical equipment.

N.P. Karpenko, director of the Chelyabinsk Pipe-Rolling Plant, stressed that no one but the enterprise itself is in a position to estimate the need for apparatus and accessories, and that in a number of new technical fields, often there is no centralized manufacturer. Six plasma cutting units were recently placed in service at the pipe-rolling plant, and the majority of the work was done by in-house specialists.

NEW APPROACH, OBSOLETE DIRECTIVES

Scientific and technical progress and the implementation of new techniques and technology is inevitably dependent upon changing the accepted relationships between different professions; these relationships have resisted ideas about primary and service personnel. For example, the extensive development of electronics and robotization will release a large number of industrial workers and attract growing numbers of specialists and repairmen whose services, it might be pointed out, have not yet been mechanized. If the current methods and directives from the State Labor Committee are carried to their logical conclu-

sion, all service personnel at the ideal flexible automated industry would be considered service personnel engaged in manual labor. This is patently absurd. There is another fact to which the participants at the meeting paid special attention. The labor grade for shop and division supervisors rises in direct proportion to the number of subordinates. Again, the precepts of obsolete directives conflict with the spirit of the intensification of production.

The guidelines laid down by Chelyabinsk employees are impressive. But the outlays required to realize the goals of the factory intensification program are no less impressive. Microprocessors, robot-technology units, laser installations, numerically controlled machines and work centers do not come cheap.

Chelyabinsk employees realize that industrial five-year plans are largely met by making capital investments. In addition, enterprises must utilize their own production development resources and bank credit more aggressively to accomplish technical re-tooling. This applies first and foremost to those who are involved in large-scale economic experiments. It is understood, however, that factors obtaining in the 12th Five-Year Plan will become a basis for the management of all enterprises in the industry. It has now become necessary to prepare ourselves and take new possibilities into account.

It is very important to develop the required standards, establish contacts with colleagues and set up direct communication lines.

Participants at the meeting expressed a number of desires directed to design organizations which increase the proportion of construction and installation work in technical re-tooling projects without justification and utilize poorly the potential for adapting new equipment to existing bases. Consequently, instead of simply replacing one heavy machine with another (not to mention a rolling mill or other unit), bases have to be rebuilt.

The question of coordinating the efforts of enterprises beginning the active re-tooling of production is not completely resolved. Combined effort is required to find a simple, reliable way to remove metal cuttings from flexible unmanned production facilities. Automation and the full outfitting of equipment with electronic devices requires the installation of a large number of sensors in whose development no one has specialized. These seemingly minor problems, which are of a general nature, must be solved jointly, not separately.

Sometimes it is better to see something than to hear it said a hundred times. correspondents visited the ChTZ, a pipe rolling plant, and the Polet Association, where they saw with their own eyes that the intensification programs are already underway. Not waiting for the arrival of new equipment, Chelyabinsk workers are reconfiguring ships and divisions and setting up equipment in accordance with GAP /main project engineering/ and robotization requirements. Personnel retraining is underway full stream.

Open discussion at a working meeting has not only revealed problems facing factory production intensification program innovators, but also pointed out that the majority of these problems are solvable in the short term. Following the example set by the enterprises mentioned above, other associations and plants in the Southern Urals are also setting ambitious guidelines for the

12th Five-Year Plan, preparing themselves to be worthy of greeting the 27th Party Congress.

8844
CSO: 1823/110

PRESSES, SPECIAL TOOLING FOR POWDER METALLURGY

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 5, May 84 pp 15-16

[Article by K.A. Golyavin, head, Voronezh Construction and Design Bureau for Forging and Pressing Machines and Automatic Lines: "Developing Technology and Equipment for Manufacturing Parts from Metal Powders"]

[Text] Compared to conventional metalworking processes for manufacturing parts out of metal powders, materials and parts with predetermined characteristics can be obtained relatively simply. Production is virtually deviation-free and the KIM [not further identified] is 0.96 to 0.98.

Calculations indicate that in mass production, as much as 1,000 metric tons of rolled steel is saved for every 1,000 metric tons of products made from metal powders, and up to 20 cutting lathes and some 50 employees are released. The overall saving amounts to over 500,000 rubles.

In order to increase the production and quality of parts made from metal powders, a large pool of pressing equipment is needed and the equipment must meet all requirements of the manufacturing and production technology.

As quality indicators of metal powder materials and products made from these materials improve, the need arises to improve the technical level of equipment producing these products, especially presses, the basic link in the production chain.

Fast-paced development in modern machine construction requiring parts made of metal powder urgently demands not only a quantitive increase in the production of presses, but also the modernization of presses already in service.

This gives rises to the need to develop the capability of improving the quality of the presses themselves as well as the technological processes for manufacturing presses.

It should be pointed out that that the interrelationship between the technical level of the equipment and product quality is particularly obvious in powder metallurgy.

The Ministry of Machine Tool and Tool Building Industry has effected plans for the types, quantities and delivery schedules for pressing equipment up to the year 1990.

Recognizing the importance of this problem, in 1981 the Experimental Scientific Research Institute for Forge Press Machine Building published "Standardization of Mold-Making Machines Used in the Manufacture of Metal-Powder Products for 1981-1985 and up to the year 1990."

Standardization is envisioned for a series of 100- to 6300-kN automatic mechanical units having broad technological capabilities for pressing powder-metallurgy products, a series of 250- to 20,000-kN automatic hydraulic presses with an improved productivity rating and a new series of 250- to 4,000-kN automatic mechanical units for calibrating.

Progressive new types of machines will be standardized: 4,000- and 6,300-kN automatic mechanical units for hot-stamping powder-metallurgy products which can produce compact design products from porous blanks; 40- to 100-kJ high-speed (impact) pressing hammers which can produce high-density products (2 to 3% residual porosity); and 40- to 630-kN automatic mechanical units for pressing hard-alloy powder products, which produce products with more accurate geometrical dimensions and density, a requirement for high-precision non-grindable cutting-tool blades.

Standardization calls for the development of technical documentation for 10 machines, the manufacture of 23 experimental units and the implementation of 24 control series.

The total number of machines to be srandardized is expanded to 44. Nine obsolete models are being retired from production and replaced by new models.

The majority of the pool of presses used to manufacture powder-metallurgy products are 100- to 1,000-kN automatic mechanical units.

At the present time in the field of pressing and forging equipment, Saranin forge press equipment factory, Pinsk forge press unit and the Chimkent Production Association are making 250-, 400-, 630-, 1,000-, 1,600-, 2,500- and 4,000-kN automatic mechanical presses.

Modifications of several automatic machines in this series have been developed to manufacture products with greater fill height or additional shoulders or recesses.

For products with a simple configuration, 250- and 400-kN automatic cam-type units are used.

Automatic hydraulic presses are made to press large items, blanks and products which must be pressed at a limited rate and held under pressure. In contrast to automatic mechanical units, hydraulic presses can be controlled more accurately over a larger pressure range, a requirement for a number of production situations involving powder-metallurgy products.

At the present time, Gidropress, an Orenburg production association, has production lines making modernized 1,600- and 2,500-kN automatic presses with twice the productivity of earlier units. In the area of heavy presses, the Dnepropetrovsk production association is manufacturing 6.3- and 10-MN modernized hydraulic presses.

Pressmash, a Taganrog production association, manufactures 40-, 120-, 400- and 630-kN automatic mechanical presses for products made of heavy-alloy powders, and Gidropress, the Orenburg production association, is making 250- and 630-kN automatic hydraulic presses and industrial prototypes for the high-temperature synthesis of hard alloys.

In the area of pressing and forging equipment, the Chimkent production association is presently production testing experimental prototypes of 4,000- and 6,300-kN automatic presses for hot stamping porous blanks for use in developing technological processes for the production of special-density and special-strength design parts.

The Serpukhov experimental factory of the Central Bureau of Forge Press Machine Building is making 63- and 100-kN automatic rotary presses for the mass production of products made from various metal and non-metal powders.

The productivity of these machines using a multisocket tool is 250,000 to 500,000 parts per hour.

The majority of the products which are sintered and subsequently pressed are repressed or calibrated. In many cases, such operations can be performed on modernized all-purpose mechanical presses fitted with simple devices. However, the presses require additional drives and calibrating blocks to manufacture most products.

In the area of pressing and forging equipment, the Pinsk forge press unit, the Barnaul mechanical press factory and the Chimkent production association have production lines manufacturing 250-, 630-, 1,000-, 1,600-, 2,500- and 4,000-kN automatic calibrating units.

Units rated up to 1,000 kN are being manufactured as pressing machines fitted with automatic feeders.

The Barnaul mechanical press factory is making 1,000-kN calibrating units for products with simple configurations based on the open single-shaft press design. A distinctive feature of these machines is the revolving-table blank feeder. At industry demand, the experimental factory of the Experimental Scientific Research Institute for Forge Press Machine Building is making units for pressing and calibrating bimetal contacts, wet pressing magnets, vacuum pressing powder, etc.

All pressing machines are equipped with powder bins and feeders, calibrating vibrator bins and feeders.

For the most part, the technical and economic indicators at a given stage of the pressing equipment in current production meet the users' specifications.

As far as technical and economic indicators are concerned, the machines are on a level with similar well-known foreign-made pressing and forging equipment.

In the next few years, the volume of powder-metallurgy production will increase.

Organizing the production of such a volume by simply increasing the production of an individual or even the entire forge press industry is not possible.

An orderly conversion to the large-scale use of high-efficiency machines and technological processes completely automating and mechanizing production is necessary.

Considering the varied small-scale and serial production of powder-metallurgy products, the development of efficient fast-readjustable standardized single- and multi-machine robotized technological plants designed with standardized automatic mechanical and hydraulic pressing and calibrating units is a radical solution of this problem.

The technological and design parameters of robotized plants should be designed for integration into flexible production systems, structured along group technology concepts.

A schedule for a promising design project has been worked out at the Voronezh Construction and Design Bureau for Pressing and Forging Equipment and Automated Lines.

First-priority tasks of this schedule are being tackled presently, including the development and outfitting of pressing equipment with mechanized and automated features which will eventually become the basic components of standardized robotized facilities: devices for stacking press blocks outside the press; devices for installing and removing press blocks; automatic devices for monitoring and adjusting product weight and thickness; robots for removing, stacking and placing products in packages or on pallets for sintering; receiving, conveying and positioning equipment to lay blanks in the right position to be grasped by a robot's arm, etc.

Simultaneously, problems of the development and modernization of press blocks are being resolved, including those used to manufacture complex parts and the final development of pressing equipment in the area of electronic units, communications between components and the press and interlocking and technological process control systems capable of integration with automatic control and automatic technological process control systems for further automation of production.

A series of automatic mechanical units rated up to 1,000 kN is scheduled for development. They will have top drive to provide the capability for manufacturing parts with complex molds with three or four transitional cross-sections. These units will be equipped with accessories for use in automated departments, plants and robotized facilities.

Plans for the production of a 630-kN prototype unit have been made.

Planning is underway for the development and implementation of a new series of automatic mechanical units, with all required automatic and mechanical accessories, for pressing and calibrating sintered products, including parts with complex configurations. They are rated up to 1,000 kN.

Subsequent to the finalization of the technological process for cold forming and dynamic hot pressing of blanks, automatic lines using 4,000- and 6,300-kN mechanical units will be developed.

Production of a 6.3-MN automatic mechanical unit, a unique 20-MN hydraulic press and other equipment will be implemented.

8844
CSO: 1823/050

STATUS OF FMS DEVELOPMENT IN ESTONIA SURVEYED

Need for Common Efforts

Tallinn SOVETSKAYA ESTONIYA in Russian 19 Apr 85 p 2

[Article by N. Shcheglov, chairman of the Section for Assisting Technical Progress Under the Technical Economic Council of the Tallinn Gorkom of the Communist Party of Estonia and Estonian honored engineer: "The Automated Plant: Plans and Reality"]

[Text] The Decree of the CPSU Central Committee and USSR Council of Ministers "On Measures to Accelerate Scientific and Technical Progress in the National Economy," adopted in August 1983, set as one of the main areas of work in developing scientific and technical progress the extensive automation of production processes based upon the use of modern machine tools and equipment, robotics installations and computers and on this basis the development of flexible production.

What is being done in the republic to introduce flexible automated production methods is described in the materials of "Search" being published here.

The increase in labor productivity, the improvement in quality and the continuous modernization of product assortment--these are the tasks confronting industry. For machine and instrument building, it is advisable to solve these by organizing flexible automated production (FMS) [flexible machining system]. By this term we understand an aggregate of machine tools equipped with robots, conveyors, storage capacity and other devices making it possible to machine the products under automatic conditions.

In addition to the basic task, that is, the capacity to effectively convert to producing a new product, the flexible production system has a number of other advantages. With a significant reduction in personnel, product output is increased, the equipment load factor is raised and labor productivity rises sharply.

At what stage along the path to flexible production are the republic enterprises? The basis of this system is a computer-equipped set of equipment mentioned above.

In particular, one of the basic elements in flexible production methods is the N/C [numerical control] machine tools.

On the whole, the republic enterprises have sufficient equipment of such kind, as they have around 150 units. However they, it can be said, are only the initial elements for creating the future mobile systems. The RET [Radioelectronic Equipment], Prompribor [Industrial Instrument] and Norma [Norm] Associations, the Pioner Plant, the Tartu Instrument Building Plant and others have reached this level in organizing FMS.

The greatest effect from the use of N/C machine tools is gained where they are simultaneously concerned with the "rear services." As they do, for example, at the Tallinn Pioner Experimental Accessories Plant. The introduction of nine N/C machine tools here was carried out in parallel with the computer-assisted elaboration of systems for automated preparation of control programs.

The use of auxiliary systems makes it possible to have an effective load factor for the machine tools. Here the use of machine time has reached from 250 to 400 hours a month, that is, the equipment has arrived at two-shift operations. Also important is the fact that an opportunity has risen effectively, in accord with the program set up in the computer, to switch to producing new dies, molds and other accessories.

Without exaggeration it can be said that at present the enterprises are preparing the "soil" for future automatic plants. Take the Norma Association of the Estonian Minmestprom [Ministry of Local Industry]. Here in the third quarter of the current year, with the aid of the Effect SKTB [Special Design Bureau] they are planning to introduce a robotized production complex for manufacturing a draw piece, the name given to a part of a safety belt. The installation consisting of three robots, a press, a conveyor and other equipment will completely replace handwork and ensure a flexible transition from manufacturing one part size to another.

Another enterprise of this ministry, the Pioner Plant, is planning over the next 2 years to establish a FMS cell, a machining center with a robotized store. The computerized ASUP [automated production control system] will ensure a rational equipment load under automatic conditions and over a 24-hour period.

There are difficult problems to be solved on the way to developing adjustable systems. The chair of machine building technology at the Tallinn Polytechnical Institute, where I have worked for many years, is giving a great deal of attention in training mechanical engineers to teaching them to use computers.

I still feel that the technical VUZes, including the Tallinn Polytechnical Institute, have not been able to promptly take into account the needs of production which in recent years have begun to intensely introduce the FMS elements. A shortage of electronic engineers has arisen. Obviously, the republic Goskomtrud [State Committee for Labor and Social Problems] and the Gosplan must study in greater detail the need of the enterprises for specialists in this area in order that the Tallinn Polytechnical Institute could make up for their shortage.

There is the special question of training workers for professions engendered by scientific and technical progress. And here a "scissors" has arisen. Although the enterprises are retraining the workers for operating N/C machine tools and automatic lines, this is not always an effective way. The regular workers at times do not want to change their profession which they have "gotten down pat" over the years. One could name the Prompribor RET and other associations where the shortage of operators for N/C equipment has led to a low load factor for them.

There is one solution. The republic vocational and technical education system should increase the training of workers for automated production which employs computers, robots and flexible methods.

As practice has shown, in working out and introducing the FMS, little use is made of the reserves for intersectorial cooperation and the experience of other enterprises. The republic has the Effect SKTB but this intersectorial organization, unfortunately, has recently been shifted more and more to introducing innovations exclusively within the republic Minmestprom under which it is administratively subordinate. This is wrong. In our view, it would be advisable to make precisely the Effect SKTB the base organization for introducing the FMS. The quotas for this bureau could be set by the republic Gosplan considering the requests from enterprises in various sectors, having thereby assumed the functions of a coordinator.

There is also another possibility for coordination, using the Republic NTO [Scientific-Technical Society] Council. The problem is that the development of flexible production methods requires the involvement of robotics specialists, electronic specialists, production engineers, designers and others. Each enterprise cannot have such a "think tank" with such a membership. But they do exist at individual enterprises. And their efforts can be pooled within the Republic NTO Council.

Moreover, this body has such experience as under it there is a volunteer committee for introducing N/C machine tools and robotics. But the needs of today have posed a new problem for us, that is, to broaden the sphere of activities and involve others in the problems of flexible automated production.

Obviously in working out the plan for the republic's economic and social development for the following five-year plan, in the appropriate section one should also incorporate measures to introduce adaptable sections and installations. Such an approach will correspond to the tasks of today, that is, to focus attention on solving the key problems of economic development.

Progress to More Advanced FMS

Tallinn SOVETSKAYA ESTONIYA in Russian 19 Apr 85 p 2

[Article by V. Mystkovskiy, chief engineer of the RET Production Association: "From Elements to an Integrated Installation"]

[Text] The Tallinn Production Association for Radioelectronic Equipment during the current five-year plan has been given the task of increasing product output

by more than 1.5-fold. For carrying this out we have selected a path corresponding to the demand of intensifying the economy and consisting in converting to full mechanization and automation of the basic types of production.

We have decided to make maximum use of the opportunities which are provided by combining control computers and flexibly adjustable equipment. Here we have wagered on flexible automatic lines, N/C machine tools and robots.

I would point out that previously we had elements of the future mobile systems, for example, the N/C machine tools. But they were operated separately. For this reason we had to establish more or less integrated controllable systems.

At present, the association in terms of the main technical and economic indicators has reached ahead of time the goals set for the concluding year of the five-year plan. And all started with the working out of a plan for economic and social development for the 11th Five-Year Plan and which included, as a separate goal, measures for the integrated introduction of automation. Five priority areas were designated related to reequipping the key types of production for us: machining, the manufacturing of printed circuits, galvanizing, assembly and final testing and adjustment.

But the plan, as they say, would remain on paper if it had not been reinforced with organizational work and a creative approach. All the more when it is a question of complex, expensive equipment requiring a special attitude. This was the case, for example, with the introduction of an automated inspection system for the parts and units prior to their assembly. Here traditionally flaw detection had been done manually. With the appearance of technically complicated products, the search for deviations from the parameters became very difficult, even for a highly skilled worker. But this is within the reach of automation.

But before calling it in for help, a specific creative group was established on working out automated program systems. The group was headed by the experienced specialist E. Markov. Another creative group headed by the engineer O. Kovalenko was involved with the printing of these systems. The result? At present, automated systems have become the dependable and irreplaceable assistant of the inspectors. They have assumed the difficult operation of circuit flaw detection and these systems are capable of flexibly adapting from quality control of certain assemblies and units to other ones.

In order to ensure high quality of the products in the final stages of the production chain, it is essential first of all to be concerned for this in all the preceding ones. And here again automation helps. For a long time, the manufacturing of one of the most important elements of our product, the printed circuits, was basically done manually. The introduction this year of automatic lines with program control by a computer has made it possible to "turn over" to the machines some 35 labor-intensive operations. Here it has been possible to rapidly shift to producing one or another type of printed circuit. Again here we have gained another element of mobile production.

Automation has arrived this year at the galvanizing sections. Multi-program lines controlled by computers make it possible to effectively switch from one production mode to another and easily adapt to producing a new range.

The next step will be a transition to automating assembly production in manufacturing the Estonia-0010 combination record players and radios. At present, in the shops they are installing automatic conveyors for transporting the parts from the storage area to the work areas with subsequent delivery of the finished product to the warehouse. Here delivery of the parts to the work areas will be done automatically considering the individual capabilities of each assembler. The computer will provide flexible adjustment of the work pace of the conveyor considering the particular features of the pace of assembly.

The machining shop is also taking the first steps toward unmanned production. Here during the current year they plan to introduce flexible modules based on N/C machine tools operating in a single "team" with robots.

Our long-range goal is to create a flexible production system whereby automation has assumed the entire cycle of operations: from the designing of the products to the delivery to the warehouse. The work of our employees has gained a new content and they, in raising their skills, will conduct as equals a dialogue with the electronic equipment. By the end of the next five-year plan there is every reason to achieve a level of mobility whereby the transition to producing new types of radio receivers, amplifiers and other products will be carried out not over several months, as is presently the case, but in 10 days or even a week. There will be no necessity for a fundamental reconstruction of the assembly process. The FMS will provide all this.

Obstacles to Introducing Flexible Methods

Tallinn SOVETSKAYA ESTONIYA in Russian 19 Apr 85 p 2

[Article by Ye. Ashikhmin: "The Blind Alleys of Mobile Production Methods"]

[Text] At the department of the chief production engineer of the Tallinn Prompribor Production Association, we were advised to visit the machine shop. Precisely here, in 1983, had been chosen a section of N/C machine tools as a testing range for introducing the first flexible production at the enterprise.

As this was the case, I was expecting production facilities equipped, as they say, with the last word of technology. It was quite natural to assume that in this section work would be in full swing in introducing flexible production methods. But what did I see? When on 28 March at 0900 hours, that is, at the very peak of the work shift, I entered the section, I did not encounter specialists involved in developing mobile production or operators serving equipment. All five modern electronically-equipped machine tools were up on blocks.

Need it be said that I did not want to see unmanned production in this manner. The equipment should operate and produce a product!

"Actually, last year we intended to introduce the first elements of flexible production methods in the section, in particular, to outfit one machine tool with a robot," said the chief of the shop A. Belov. "But for now, as you have seen, plans have not gotten any farther. As for the N/C machine tools, they work at best one shift."

Why the modern, expensive equipment is being used inefficiently will be taken up later. For an explanation I turned to the deputy chief engineer A. Ivanov who in the same 1983 began to be concerned with the questions of introducing the flexible automated system.

"With the help of the All-Union Production Association [VPO] Soyuzprompribor [Industrial Instrument] we wanted to obtain the funds and receive the "okay" for introducing the FMS, but the VPO did not support us," explained A. Ivanov.

A good deal of time has passed since 1983, when the Tallinn instrument builders proposed a good idea. The FMS was to "provide an opportunity to introduce unmanned production methods in manufacturing parts like a flange and housing, it could easily be adapted to machine one type of product and then another and replace the operators," stated the technical specifications submitted to the VPO. Seemingly there in response they should have seized with both hands the idea of the Tallinn workers which promised an economic gain.

But what happened? As strange as it might seem, the Prompribor employees could not demonstrate this very economic effectiveness to the VPO and the association, in turn, did not give its "okay" for introduction. This was confirmed in a phone call with the senior engineer of the technical department of Soyuzprompribor V. Slutskiy who was following the activities of the Tallinn Association.

I asked A. Ivanov how the calculations of the proposed economic effect had been made. It turned out that they were based on the work of a flexible system not on three shifts or even two but rather one. Need one be amazed that such weak arguments did not persuade the association's employees. But this is still not all. V. Slutskiy mentioned other problems:

"Prompribor has still not developed all the possibilities of the ASUP put into operation in the middle of last year. Certainly the ASUP is the basis of a flexible production system. The association should also show the possibility of more effectively loading the N/C machine tools. Only then can it be a question of a flexible production system. And it is a question of allocating a good deal of money."

Now let us turn to the figures which were given to me in the department of the chief production engineer. Last year the shift factor for a group of lathes which includes N/C equipment was just 0.76. That is, the equipment was loaded less than one shift. This, generally speaking, did not contradict my observations.

As for the ASUP, it is still too early to speak about this system as a sound basis for adaptable production. According to the calculations, the annual economic effect from introduction should be 570,000 rubles. That is, by the end of the year the expenditures could be repaid under one condition: if the ASUP will be able to solve all the problems required for operation. However, the chief of the enterprise computer center A. Korsunskiy had far from optimistic forecasts:

"At present, only 8 out of the 41 problems is being solved."

"Unfortunately, our association lacks production engineers and designers capable of introducing the FMS," said the chief of the Mechanization and Automation Department, O. Popov.

Where are the specialists to come from? The chief engineer V. Grunin feels that there is a solution:

"If we were to operate according to the full ASUP program, then we could release scores of specialists. They would strengthen the departments and bureaus determining the association's technical policy. Obviously we must even establish a FMS department."

But there is a means to increase the output from the specialists even now, utilizing the opportunities granted by the experiment. The designers and production engineers are offered extra pay for developing and introducing efficient technical innovations. But this incentive for increasing the creative return as yet has not been employed here. This is a pity. I would point out in passing that effective operation of the N/C machine tools is also not provided with any incentive. For this reason the workers are reticent to master the new equipment. Does this not partially explain my unsuccessful attempt to find the operators at work during the high point of the shift?

Let us take a look at the shop. From here are sent to the customers thousands of flow meters, heat meters, dust sensors and other devices. Still the demand for them is not met. The mobile production methods could help increase product output. Understandably the development of these methods entails difficulties.

However, one cannot help but recognize that over this time much more could have been done at the association with initiative and professionalism. Flexible production, like any complicated technical innovation, also presupposes a flexible approach to its introduction.

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CSO: 1823/116

DRIVE TO DEVELOP FMS TECHNOLOGY VIEWED

Moscow PRAVDA in Russian 11 Nov 84 p 1

/Article: "At a New Stage of Automation"/

/Text/ Our industry has accumulated much experience in the automation of production. New machines and automation have become an important factor in the growth of labor productivity, improvement of product quality and bettering of the working conditions of millions of people.

Today, in compliance with the resolutions of the 26th CPSU Congress a new and higher stage of automation is beginning--the use of flexible manufacturing systems. This will accomplish a thorough automation of production by combining NC machine tools, industrial robots and automated control systems of technological processes into an integrated system. So-called flexible manufacturing allows enterprises to switch routinely to the output of a new product at minimal cost and time, using the exact same equipment.

The development of such systems is a major trend in the evolution of mechanical engineering and the intense technical reoutfitting of the industry on the basis of resource-sparing technologies and quick-readjusting production. This creates the possibility of radical improvement in the labor productivity by a factor of 2-5 or more. The automated equipment will operate in three shifts, sharply reducing the amount of manual operations and the labor requirements.

The development of flexible manufacturing systems is a complciated and comprehensive scientific-technical problem. Its successful solution requires further consolidation of the ties between science and production and a unification of the efforts of scientists at the academic and industrial insttitutes, experts at the machine building ministries and the collectives of the industrial enterprises. It is important to carry out this work expeditiously, with careful coordination of the efforts of all participants and profiting from the past experience.

There are already dozens of automated sectors and shops based on flexible systems in operation at Soviet enterprises. Useful experience has been gained by the Dnepropetrovsk Electric Locomotive Building Plant, the Zhal'giris Plant of Vilnius, the Ivanov Machine Tool Construction Association and other enterprises. The geographical utilization of these innovations is constantly

expanding. Preparations are underway to introduce a large-scale flexible manufacturing system at one of the foremost domestic machine tool industries--the Krasnyy Proletariy Plant of Moscow. After reconstruction, the Avtomoskvich Association of Moscow set about adoption of flexible manufacturing. A number of enterprises have extensive programs for development of prototype flexible automated sectors, manufacturing lines and shops with limited human involvement. These will become the nuclei of the industry of the future. At these veritable proving grounds the new methods of production organization will have to be worked out. Moreover, the new operation should also provide a quite tangible savings on production space and labor resources, reduce the cost price of the products and improve their quality.

The scientists working in the field and those at the Academy of Sciences, and the experts of the USSR Gosstandar , will be called upon to make a major contribution to the development of the new initiative. The rational areas of application of flexible manufacturing in the branches of the economy must be scientifically established and the technical-economical foundation must be prepared for use for all kinds of components in machine building and assembly of products, taking into account the various series production of their output. The industries are waiting for clearcut, specific recommendations from the scientific institutions and the management staffs. The party committees of the ministries and scientific institutions should keep this work under unslackening supervision in order to complete it during the allotted time.

Much will depend on a timely improvement in the qualifications of the industry's specialists. This will require development of a system of training, retraining and certification of the engineering-technical cadres for prompt mastery of the procedures of development and operation of flexible manufacturing. The Minvuz USSR should provide concrete assistance to the local ministries in this regard.

The most important direction of work is the creation of the technical base of the future industry. The machine building ministries will have to arrange for a prompt production of the necessary quantities of high-capacity quick-retooling machine tools and aggregates, automatic production lines, industrial robots, tools and appliances, transport/handling and technological equipment, control computer systems and integrated items. First on the agenda is the organization of large-scale production of flexible manufacturing modules for machining, forging, metal casting, painting, welding and assembly work. The USSR State Committee on Science and Technology, as well as the Ministry of the Machine Tool Industry as the leading ministry, should pursue a consistent technological policy in these matters and coordinate all the efforts in this field. Together with the Gosstandart USSR, they should quickly develop the standards and technical documents to avoid duplication of effort and more fully utilize the advantages of unification and standardization.

The share of human involvement in production processes is greatly curtailed at the highest level of automation. However the requirements for dependability of these manufacturing systems increase by an equal amount. This difficult problem must be solved by the machine building specialists.

The creation of flexible manufacturing systems is quite expensive. Practice suggests that it is logical, given the specific factors, to create regional centers where such production is concentrated. This will allow a significant boost in labor productivity and return on investment, and will free up a large number of workers.

The future of our industry, its technical base and methods of organizing production are being created at the present. The party organizations of the ministries, design bureaus, project development institutes and enterprises, while handling their routine assignments to fulfill the annual plan and the 5-year plan, should at the same time attune their collectives to the fastest development of the new production processes. This work should be tackled with dedication, efficiently managing a unified production line and dealing harshly with those marking time or hampering the scheduled work times and work volumes. In this way, flexible manufacturing will be sooner available to the national economy. Relying on this, our economy will achieve a major advance.

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CSO: 1823/112

PRODUCTIVITY, QUALITY GAINS FROM FMS DISCUSSED

Kiev POD ZNAMENEM LENINIZMA in Russian No 19, Oct 84 pp 64-66

[Interview with B. B. Timofeyev, director of the Kiev Automation Institute imeni 25th party congress of the USSR Ministry of Instrument Making, Automation Equipment and Control Systems, academician of the USSR Academy of Sciences, by our correspondent, date and place not specified]

[Text] The successful realization of the goals set by the 26th party congress and the following plenums of the Central Committee of the party on raising the efficiency of social production and transferring the country's economy to primary intensive development is related closely to the acceleration of scientific technological progress and the wide and rapid introduction into production of the achievements of science, engineering and advanced experience. B. B. Timofeyev tells our correspondent about several aspects of the creation of new, progressive technologies.

[Answer]: In increasing the rates of growth and achieving the highest standards of productivity of social labor, it is decisively important to master the latest achievements of the scientific technological revolution. Based on that, the economic and scientific technological policy of the party envisions an accelerated introduction, in all sectors of the national economy of new progressive technologies which are the most efficient direction in scientific technological progress. We arespeaking, primarily, of new in principle technologies based on fundamental research and great discoveries. They make it possible to raise labor productivity by several times and, in some cases, by dozens of times. This happened, for example, with laser and plasma technologies, powder metallurgy etc.

Several thousands of kinds of machines, devices and apparatus are being assimilated in our country every year. But technological processes? Not over a hundred. And of these, only even a part is new in principle.

Thus, the development of new promising technologies is especially urgent now.

[Question]: What specific features do advanced modern technologies have?

[Answer]: First of all, technologies that require a minimum number of operations, continuity, wasteless, are well provided with materials and power, save labor, reduce losses and waste, have automatic process controls according to a given mode, and optimized by computers.

We can say that in the mininng sectors new technologies will make it possible to involve ores which were previously considered unpromising. Here, improved mining methods will improve the extraction of minerals considerably and will not pollute the environment.

Thus, new methods and facilities will increase the yield of petroleum-bearing strata, coal, nonferrous metal ores and other minerals, making it possible to increase the yield of useful raw materials by 15 to 20 ercent. The new technologies will also have a great effect on the utilization of power, material and equipment resources, and the reduction in labor.

Considerable saving is being promised by changing over power consuming production facilities to an efficient combination of processes that are accompanied by the liberation and absorption of heat. This, we stress, is a reliable way to the most efficient production. It is already being used by leading design buros in the country, in the designs of chemical, metallurgical and machine building enterprises.

Technology has a more noticeable effect on the development of new materials and designs for equipment. The complexity and precision of machines are increasing so rapidly that providing technologies for them is becoming no less a serious problem than machine design.

Automation is becoming important for the development of machinebuilding production.

[Question]: Modern machinebuilding is approximately three-quarters series and small-series production. Rapid renovation of the list of products is related to the operational rearrangement of production facilities at enterprises. A new in principle outlook on an efficient technological structure for production facilities follows from this. Organizational-technical facilities, efficient in automating mass and single-product production become a brake when it is necessary to renovate the products. What is the way out here?

[Answer]: Life shows us the way. It is a course on rapidly readjustable production facilities. The development and wide utilization of industrial robots and NC automatic manipulators have an important place in their creation. They are called upon to replace people in doing hard operations dangerous to health. Along with other modern equipment, automatic manipulators open up ways to create production modules -- the basic links in automatic sections and shops which can be reequipped efficiently for the production of new products.

Due to modern automation facilities, it is possible to tie the entire technological chain into a single complex. It will include the design of machines, equipment and fixtures using an automatic design system (SAPR), technological process control by an automatic technological process control system (ASUTP)

and production control as a whole by an ASU [Automatic Control System]. This will be facilitated considerably by the development and expansion of various kinds of computers from large ones to microprocessors.

ASUTP has a considerable effect. As a rule, they pay for themselves in one-two years, about twice as fast as in other scientific technological progress directions.

The situation is that the ASUTP do not require new buildings or new power capacities to be introduced. Automation has increased the productivity of existing machines, reduced unit raw materials and power consumption and improved the quality of the product. At the same time, acquiring devices, computers and systems design is comparatively inexpensive.

Let us say that the automatic system for controlling melting in the electrical furnace at the Donetsk Metallurgical Plant cost 460,000 rubles, while it saves 360,000 rubles ann ally. The introduction of an ASU dispatcher control at the "Kievenergo" cost 2.8 million rubles. This saved 1.5 million rubles annually.

The ASUTP developed most rapidly in the seventies. In the current five-year plan period, it is planned to introduce more than 550 such systems.

The efficiency of automation facilities and computers is achieved by the comprehensiveness of application. Their uncoordinated utilization, as a rule, shows only a small part of their possible economic effect. Automation facilities combined into one produce a greatly multiplied economic effect and introduce radical changes in the technical standard of production. An example of such an organization of enterprises in the very near future could be flexible automated production facilities based on combining robotized complexes, transportation and warehousing facilities and computers.

[Question]: Please tell us about this new phenomenon in industry in greater detail.

[Ansser]: High rates of production development and demanded requirements have expanded the product list and its structural complexity sharply while the time for assimilating new goods and machines has decreased sharply. These new trends originated against a background of the scarcity of labor, especially of skilled labor.

It is not by chance that changing products without stopping production is considered an outstanding achievement. Yet, such a change should be an ordinary event, compulsory for modern high efficiency production which is always ready to stop the manufacture of one product and, in a short time, switch over to an output of new products with better consumer properties rapidly and without harm.

All these important features of modern production are characterized by the word "flexibility," which means easy adaptability of production to the market and to the constantly increasing demands of the people and the national economy.

When changing products in any production facility it is desirable to change the technology as rapidly and as cheaply as possible, not discarding available equipment, i.e., by maximum saving of past physical and intellectual labor. Flexible automatic production facilities make it possible to do that as well as possible because their technical base is NC equipment, industrial robots and computers whose reequipment is reduced to replacing control programs.

Strictly speaking, flexible automatic production is possible at various levels. The lower level, a peculiar foundation, is the flexible production module. It is an easily readjustable and independently functioning unit of NC automatic equipment, equipped with devices for loading intermediate products and transporting machine parts by robots for feeding and changing tools, and "sweeping out" waste. The module can not only change rapidly to manufacture and assemble various parts or units within technical possibilities of the equipment, but also it can be easily built into flexible production complexes, lines or sections.

The flexible complex is the basic level of automation consisting of two flexible interconnected modules tied by an automatic transport-warehousing system for the automatic supply of tools. A single computer synchronizes the operations of the modules in this case, as well as controlling the entire production cycle. It insures rapid reprograming of the equipment for machining another part or unit.

A flexible automatic production facility (shop or plant) consisting of two and more interconnected flexible complexes is considered the top of automation. The way to this is full automation of engineering labor and production at all levels, as a result of which the production facility acquires, along with flexibility, high efficiency and becomes almost "manless."

Flexibility of production is its greatest competitiveness and commercial productivity. In fact, the number of workers in flexible automatic production facilities is minimal. Here the latest achievements of science and technology are combined in the best possible manner.

Flexible modules and complexes must beused widely primarily in small series production of a great variety of products. This is the opinion of scientists, as well as practical people.

However, the question arises on what basis to build flexible automatic production facilities -- on the basis of new equipment, for example, especially designed NC machine tools or utilizing the old?

In the first case, the cost of the complexes would be too high, while in the second case -- very large expenditures of labor and facilities for "wedging in" traditional equipment would be necessary. Obviously, the most advisable way appears to be modular design from standardized units. This would sharply increase their number and would reduce their cost considerably and simplify their production.

It should be added that the modularity of structures, high variety of standardized units with a high degree of prefabrication, along with the wide use of computers in planning and design make it possible to accelerate and introduce flexible modules and complexes four to five-fold as compared to the present rate. In fact, it is possible to build any machine tool, welding or another installation with the necessary characteristics from standardizad units efficiently. When necessary, such flexible complexes can be dismantled into units and new equipment assembled from them with other specifications sensibly saving past labor.

Calculations and studies show that about ten mass production technologies can be automated by using the latest material treatment processes and computers. This, in particular, applies to the design of dies, castings, fastenings, using special welding and powder metallurgy methods.

The creation and operation of flexible automatic production facilities requires the development not only of design, but also technological systems for design automation.

We must remember that modern machinebuilding uses over 4000 different technologies. The same variety exists in the kinds and designs of equipment on which various processes are implemented. Together with fixtures they must be designed automatically by computers.

However, for this it is necessary to create a large number of systems to automate design and control. Therefore, the last word is that of science. Scientific centers are already being created in advanced sectors of machinebuilding for flexible automatic production facilities.

[Question]: How efficient are flexible automatic production facilities?

[Answer]: So far we do not have enough practical experience in flexible automation. But we know that the introduction of a flexible complex for machining complicated housing parts on "machining center" type machine tools in combination with an optimal robot system increases labor productivity 2 to 2.5-fold and halves the number of machine tools needed to fulfill the plan. At the same time, this increases the output-capital ratio by 15 to 20 percent and saves 20 to 30 percent of the turnover capital due to a reduction to about a third of the production cycle for manufacturing parts. Other advantages are that they improve the standard of production considerably and create conditions for clear-cut, regular operation of production subdivisions. The quality of the product will increase and also the nature of labor changes since the share of intellectual activity increases, while that of physical activity is reduced to a minimum. To this must be added an increase in the loading coefficient of equipment and of the shift coefficient.

At the January (1984) Plenum of the Ukraine Communist Party Central Committee it was stressed that very important work on creating and widely introducing automatic technological complexes and flexible (readjustable) production facilities and technologies is being implemented at the "Kievtraktordetal'" and the Ternopol'sk "Vatre" associations, at the Dnepropetrovsk Electrical Engines Plant and at other enterprises. This year it is planned to mechanize and automate 1700 enterprises and sections in the republic comprehensively.

I would like to call attention to two serious problems: the provision of the reliability of the operation of the equipment in flexible automatic production facilities and of highly durable tools. At present, a mass output of universal, typical flexible modules is necessary. Consumer enterprises must arrange them in place into flexible complexes whose prototypes with corresponding software must be created in industrial scientific centers.

AT one time ancient philosophers attempted to prove that "numbers control the world." Taking into account the modern development of science and industry, it may be stated without exaggeration that numbers control production. Never seen before possibilities have opened up for automation and the elimination of manual labor. Flexible automatic centers are a powerful lever in accelerating scientific tec nological progress.

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CSO: 1823/113

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